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Basic Oxides and Properties of Glass

by DR. NORBERT KRIEDL

Presented at the Eleventh Technical Glass Meeting, Vienna[1]

OUR industry, the glass industry, is one of the oldest. Glass has been made for thousands of years, but in the scientific knowledge of our material we are far behind other branches of industry which have made use of modern physical and chemical methods. For in a very general way the work on silicates involves great experimental difficulties which are due to the fact that they are slow to react and require high temperatures. These are the reasons which caused the chemistry of the silicates to be so greatly disregarded in inorganic chemistry up to recent years.

In a purely empirical manner the glass industry has left the simple composition of glass as practically suggested originally by nature, and has further developed it as the field of

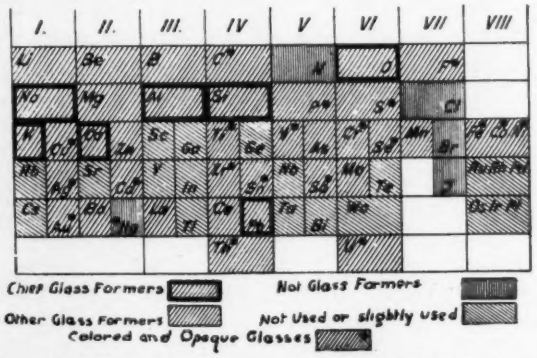


FIG. 1. PERIODIC SYSTEM OF ELEMENTS, INDICATING THE IMPORTANCE OF THE ELEMENTS AS REGARDS GLASS

application of this material became broader and more specialized. Thus for example, there were the old stained glasses. The stricter requirements that the optical industry, in its rapid development, placed on its material, glass, could no longer be met satisfactorily by empirical methods. At this time the systematic investigations of Winkelmann and Schott were made. New materials were introduced for the formation of glass, and thus systematic scientific research of the glass-forming elements was started. A glance at the periodic table of the elements shows us that most of the elements could be used for the formation of glass (figure 1).

The only elements that are entirely without importance are mercury, nitrogen, chlorine, bromine and iodine (vertical shading in figure 1).

However, of the glass forming elements, a large part of them are not used in practice because of their scarcity and for economic reasons: for example, the alkali metals rubidium and cesium, by whose introduction we will not expect to obtain any special properties (shaded obliquely to the right in figure 1).

The important elements for glass formation are shown by oblique shading to the left. A heavy line has been drawn around the constituents of classical glass. Of these elements, those that give glass a characteristic color or opaqueness are emphasized by a dot.

Because of its low atomic weight, lithium is suitable for the manufacture of glass transparent to x-rays, and in combination with beryllium as lithium-beryllium borate, it is also used for the so-called Lindemann window.

The use of copper and gold for ruby glasses is known and silver is used in order to obtain a yellow color effect.

The partial replacement of lime by magnesium has become of particular importance in mechanical working of glass, and this will be taken up later.

Barium gives glass a greater density and refractive index and, aside from optical glasses is also added to ordinary glassware in order to make them more like crystal.

The addition of zinc within certain limits increases the chemical resistance.

Cadmium is an essential constituent of the yellow glasses, in which it is present as sulphide.

Boric acid is used to make a glass melt more easily. At the same time it reduces the coefficient of thermal expansion and, accordingly, it makes the glass more heat-resistant. Finally it stops devitrification.

The rare earths related to lanthanum have already been used for a long time as decolorizing agents, and have recently assumed importance in the production of certain artistic color effects.

The part played by the carbon in glass probably has not been completely explained even at the present time, as the yellow coloration of glass, characterized as the carbon color, is possibly due to only a reducing action with sulphates.

The oxides of titanium, zirconium, thorium and tin give a turbidity to glassy enamels.

An addition of cerium causes a strong absorption of ultraviolet rays without essentially weakening the visible radia-

[1] Translated from *Glastechniche Berichte*, 1929, vol. 7, pp. 313-317.

Table 2. SCRATCH HARDNESS

Foreign oxide that replaces SiO_2 in the basic glass.	Basic Glass	Volume % of Exchanged Oxide 0—5 %	5—10 %	10—15 %	15—20 %	20—25 %	25—30 %	30—35 %
		Average Specific Difference in Action						
Na_2O	80 SiO_2 . 20 PbO	—	—	— 5	— 5	— 5	—	—
K_2O		—	—	— 4	—	—	—	—
MgO	82 SiO_2 . 18 Na_2O	+ 5	+4,6	+ 3,8	—	—	—	—
CaO		+ 2,4	+3,6	+ 8,6	—	—	—	—
ZnO		+ 4,6	+4,4	+ 4,0	+3,8	+0,3	+0,3	—
BaO		+ 4,2	+3,2	+ 2,6	+2,0	+1,4	—	—
PbO		— 0,3	—0,3	— 0,3	—0,3	—0,3	—0,3	—0,3
B_2O_3	82 SiO_2 . 18 Na_2O	+15	+7	— 4,8	—7,6	—9	—9	—
Al_2O_3		+ 2	+2,7	— 3,6	—	—	—	—
Fe_2O_3		+ 4,8	+1,0	0	0	—	—	—

tion, so that cerium glasses exert a special protective action as eye-glasses. Vanadium and uranium exert a similar effect.

As is known, arsenic is used for clarification, but there are no systematic investigations on the part played by arsenic and antimony in glass.

Phosphoric acid has some importance as a glass-former for optical glasses (phosphate-crown). It is also the chief constituent of bone-ash which is frequently used for making glass opaque.

Sulphur and sulphur compounds are used for the production of many colored glasses.

Selenium is used for the production of selenium ruby glass and as a decolorizing agent.

Chromium, iron, cobalt and nickel are used as coloring agents and it is interesting that iron, in its divalent stage of oxidation, absorbs heat rays and thus offers a certain protection against heat.

Manganese is also used for coloring. This was the classical decolorizing agent.

Of the halogens, only fluorine is of any great importance as a constituent in many agents that make glass opaque.

Aside from the effects intentionally mentioned here, certain additions naturally also change the other properties that are important for the glass maker. The requirement for a quantitative comprehension of all changes in property due to each individual component, caused Winkelmann and Schott to work out the system of their glass constants. They gave each oxide a factor for each property, which is multiplied by the percentage present. The sum of this individual effects gives the desired property numerically. Thus for example, we calculate the expansion coefficient, of a simple soda-lime glass in accordance with table 1.

Table 1

CALCULATION OF THE EXPANSION COEFFICIENTS ACCORDING TO WINKELMANN AND SCHOTT

Glass Batch	Composition of the glass		Expansion Constants	X x%
Sand ..... 81 kg.	SiO_2	80 %	0.8	72.0
Soda ..... 29 kg.	Na_2	14.5%	10.0	145.0
Marble ..... 11 kg.	CaO	5.5%	5.0	27.5

Expansion coefficient of the glass = 244.5×10^{-7}

Unfortunately, this method of calculating constants can be used only to a restricted extent, for in most cases the change in the properties is not proportional to the quantity added. Frequently the effect of an addition is even reversed with increasing amounts, as is shown in a characteristic manner by boric acid.

For these reasons it is more correct to start from ordinary basic compositions and to follow the action quantitatively by gradual addition of them individually. This method was done principally by Gehlhoff and Thomas in their work, which is so valuable for the practical man. They proceeded to replace the silica in certain basic glasses, such as 82 SiO_2 and 18 Na_2O, by increasing additions of a series of other oxides and thus found the effect of them for certain intervals, expressed in the form of comparable tables and curves. Table 2 shows such an investigation of the scratch hardness. The numbers give the change in scratch hardness of the basic glass (151) for each 1 per cent of the oxide in question within the given percentage range. For example, for 7 per cent MgO: for 0—5 per cent + 5 for each per cent, that is $5 \times 5 = 25$. For 5 — 10 per cent, + 4.67 per cent and therefore 9.2 for 2 per cent in this region. $25 + 9.2 = 34.2$. This, added to the scratch hardness of 151 for the basic glass, gives 185.2.

The knowledge of the action of an addition to single important basic glasses always gives the practical man an indication of the effect to be expected in his glass; but it is only an indication, for the effect of an oxide is different in each basic glass. The following observations will show that we have to do not only with experimental difficulties, but that it is even impossible to speak in a general way of the typical action of an oxide. Glass consists of a mixture of different silicates which are associated and dissociated in varying amounts. Since the equilibrium between the silicates that are forming, their association and dissociation, varies with the temperature, the heat treatment during melting and cooling also influences the properties. Every glassmaker knows the effect of an addition to the body. Also, the very same addition in different basic glasses can take part in the formation of radically different kinds of molecules. This is especially pronounced with those elements which can act as acid as well as base in the formation of glass. This amphoteric character is found in aluminum and zinc, as is known. But there is also the possibility that other oxides may show a similar action. As an example I may mention magnesium oxide, the action of which I can next explain from this viewpoint.

The expansion coefficient is influenced differently by MgO, according to whether it is put in a basic glass rich in acid or alkali. Baillie accordingly differentiated between two factors for MgO, for glass rich in acid in glass rich in alkali. This view is supported by the minerological-crystallographic action of Mg.O. In this respect it differs greatly from the

pronounced basis calcium oxide. According to a paper by Weyl, for example, it is not possible to partially replace CaO by MgO in calcium ferrite.

These processes, spoken of as the complicated constitution of glass, makes it impossible to calculate exactly the properties of a given glass merely from its composition.

The action of oxides on viscosity and thermal expansion is of particular interest in glass working.

The glass must have a certain viscosity when working

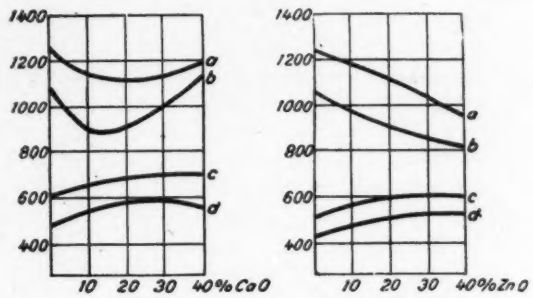


FIG. 2. TEMPERATURE FOR EQUAL VISCOSITY ON REPLACING SiO_2 by CaO or ZnO

starts and at the end of the working period. If, after great cooling, the glass is too viscous and therefore useless for working after a rather long time, it is spoken of as "long" and if it is the reverse, it is called "short." This property, which is so important in automatic operation, can be considered physically as follows:

1. How great is the temperature change that is necessary in order to bring the glass from the lower initial viscosity to the higher final viscosity?

2. How do these temperature intervals differ according to the percentage content of a given substrance that is added?

3. How do they differ with different materials that are added?

It is not essential for the practical man to know the absolute values of viscosity as have been systematically determined by Washburn, English and Turner and also Margules. It is sufficient for him to know the two temperatures for two given viscosities, the limits of the working interval, and as a matter of fact, in relation to the composition.

In 1926 Gehloff and Thomas published a paper from these viewpoints, in which the relation of composition to temperatures was given, corresponding to some essential viscosities. These so-called viscosity temperatures were determined for four viscosity values, of which two (10^3 and 10^4 C G S units) were approximately within the working range. The curves in figure 2 show how a replacement of silica by CaO or ZnO in a given basic glass changes the viscosity temperatures in a different way, and they obviously characterize the working interval. We can see from the figure that the working interval is shortened by a higher lime content. The addition of zinc changes the viscosity in an entirely different manner.

A second important question is the expansion coefficient, especially for glasses for covers. It can be calculated fairly well from additive factors, but in proving the principle, one has very frequently corrected the Winkelmann-Schott coefficients. Table 3 shows how great these corrections were.

Table 3

EXPANSION COEFFICIENTS

Oxides	Winkelmann and Schott x 10^{-7}	English and Turner x 10^{-7}
SiO_2	0.8	0.15
Na_2	10.0	12.96
K_2O	8.5	11.7
CaO	5.0	4.89
MgO	0.1	1.35
Al_2O_3	5.0	0.52
BaO	3.0	5.2
PbO	3.0	3.18
ZnO	1.8	0.21
Zr_2O_3	2.1	0.69
B_2O_3	0.1	1.98

The particularly great differences shown by Al_2O_3 and MgO possibly have some connection with their amphoteric nature. These corrections by English and Turner have since been confirmed on some glasses by Kitaigorodsky and Rodin (table 4).

Table 4

EXPANSION COEFFICIENTS OF GLASSES

Glass		Expansion coefficient Observed x 10^{-6}	Calculated according to W & S	Calculated according to E & T	Differences in % W & S	Differences in % E & T
	404	648	859	654	+32.6	+0.9
Al	410	770	981	794	+27.4	+3.1
Glass	411	740	921	692	+25.5	—6.5
	415	740	964	729	+30.2	—1.5
Al-Mg-	408	747	941	761	+26.0	+1.9
Glass	409	675	871	661	+29.0	—2.1

The last two columns show the differences between the measured values and those calculated according to Winkelmann and Schott, and English and Turner (W. & S. and E. & T. respectively).

From the standpoint of practice, the following should be stated in connection with the expansion coefficients:

1. The expansion coefficient depends to a great extent on the melting process and especially on the temperature and additions to the body.

2. The difficulty in the predetermination for glasses for cover purposes is still further increased by the action of the opaque glasses. Their expansion coefficients vary with the degree of opacity, because the degree of opacity is a measure of the precipitated crystalline phase which has a different expansion coefficient. The factor 7.4 given by Havas for cryolite, is thus questionable in practice.

3. It is known that the expansion coefficient depends greatly on the cooling, up to 15 per cent.

The reasons given first, make the ring test determinative in mixtures carefully kept constant. The phenomenon mentioned last depends on the fact that a ring test with a moderate result still permits working under certain conditions. Since one glass is affected by the cooling process in a manner different from a second, it is possible, by a different adjustment of the cooling temperature, to prevent breaking. In practice this is done entirely empirically, and it certainly would be of interest to make quantitative experiments here, which are entirely within the field of the melter. For even

this variation of the expansion coefficients is very different for each glass.

Discussion

PROF. GEHLHOFF: I shall now open the meeting for discussion.

DIPL. ENGR. R. SWINNE, Berlin-Siemensstadt: The author of the paper seems to tend to ascribe these variations primarily to the fact that oxides have mixed amphoteric properties, and thus such a calculation cannot be made. He assumes this for magnesium oxide in particular. Although I am inclined to accept his assumption for aluminum oxide, I cannot accept it for magnesium oxide.

DR. NORBERT KREIDL, Vienna: I should like to remark that of course this is not the only reason making it impossible to carry out an exact calculation of the glass properties from the properties of the components. This is only one of the causes that take part in it. As regards magnesium oxide, it has been determined that it acts in an entirely different manner than calcium oxide, which is also shown in the crystallographic properties of its compounds.

DIPL. ENGR. W. WEYL, (S. F. I.) Berlin-Dahlem: In the course of my synthetic and X-ray investigations on spinels and particularly on magnesium ferrite, it was found that MgO acts in a manner entirely different from CaO. It was not possible to get magnesium ferrite from well-crystallized calcium ferrites by partially replacing CaO by MgO. The corresponding aluminates and chromites are also entirely different.

DIPL. ENGR. R. SWINNE, Berlin-Siemensstadt: Magnesium ferrite doubtless exists. I have made it, as well as other ferrites. A paper on this will appear shortly. Further investigations are being made. Magnesium oxide crystallizes in the same structural form as calcium oxide, in the rock salt lattice, while beryllium oxide shows a tetrahedral atomic combination and crystallizes entirely differently. Differences in additive behavior are certainly to be expected if we consider that glasses are not simple oxide mixtures, but contain additive combinations of oxides. The stability of such additive combinations evidently depends on the oxides that are brought together: We can understand in this sense the abnormal action of magnesium oxide in certain glasses.

Making Colored Glass a Century-and-a-Half Ago

by S. R. SCHOLES[1]

Colored glass was probably the first sort to be made anywhere. Indeed, it is doubtful if either raw materials of sufficient purity, or adequate skill in handling decolorizers, were available for the production of crystal as we know it today, until comparatively recent times.

Few of the really ancient formulas have come down to us. But, toward the end of the 18th century, the urge for the imitation of precious stones seems to have led to research on colored glasses. The account of some of these studies, by a Frenchman named Fontanieu, has come into my hands. An abstract of it may be of interest.

The pamphlet which I have, containing methods and recipes was translated into German by one "D. R.," and is dated 1781. It was given me by Dr. Kai-Ching Lu, formerly of Ohio State University, now returned to China.

If we recall that in 1781 oxygen was a recent discovery, Lavoisier had not yet made chemistry a quantitative science, and no one had learned that "calces" are oxides, our appreciation of the results obtained by such glassmakers as our author will become greater. We are not reviewing his work for its technical value, which is negligible in view of the wealth of published information now before us. But painstaking work of this sort, without the guidance of scientific knowledge, is to be admired for its own sake.

Moreover, such work should spur us to believe that in our own day, with our laboratories and libraries, glass technology ought to be developing even faster than it is. Such problems as the rôle of arsenic, the control of dissolved gases, or the corrosion of refractories, should quickly yield, if our results measured up to our facilities as well as did Fontanieu's to his, a half dozen generations ago.

* * *

The work of former experimenters having been carefully reviewed and followed with indifferent results, this investigator set out upon researches of his own. He now attempts to describe his methods so that, "if one follows them, he can as well attain his purpose."

In the first section of his booklet, he treats of the preparation of batch materials. Various forms of lead-earths he finds not equally good—they may be adulterated. White lead often contains chalk; lead scale (litharge) hides bits of metal; red lead he deems the best form. This he sifts, to remove large particles and metallic lead. The basic glass for artificial gems being a melt of lead "calx" and rock crystal—or some other sandstone changed to glass by means of fusion with a lead preparation—, a suitable sand is his next care. Flint, rock crystal, or pebbles from a river will serve. The stones must be finely powdered, but this may introduce iron. Therefore he prefers to heat the pebbles to redness in a crucible, and quench in water, thus shattering them. The cinders and other light impurities float out. The clean sand sinks, and is dried and sieved. Then follows digestion in hydrochloric acid, which removes much of the iron. Another washing and drying, and the silica is won—what price per carload, we wonder? The completeness of the washing, incidentally, is determined by litmus test, in quite modern fashion.

Saltpeter, salt of tartar [potash], and borax are the fluxes he uses. Soda is not mentioned; perhaps he had none, or perhaps the available sort was not pure enough.

[1] Technical director, Fostoria Glass Company.

The second section describes Fontanieu's several crystal foundation-glasses or frits for his imitation gems. After a great number of trials, he finds his limitations as to using lead as a flux.

Too much lead makes his glass "decay" (devitrify). But by increasing alkali at the expense of lead, he makes his glasses safe against "decay."

Melt (1) specifies: 2½ parts white lead, 1½ rock crystal or prepared flint stone, ½ saltpeter and as much borax, and ¼ arsenic-glass. This is melted in a Hessian crucible, and when completely fluid, poured out into cold water. This process is repeated twice, in fresh, pure water, and the reduced lead separated from the glass. Fontanieu warns against using a crucible a second time, and prescribes covering the melt from the reducing action of coals that may drop into it.

Melt (2) requires 2½ parts white lead, 1 of sand, ½ salt of tartar and ¼ calcined borax—process carried on as before.

Melt (3): 2 parts red lead, 1 sand, ½ saltpeter, ½ salt of tartar.

Melt (4): 3 parts calcined borax, 1 sand, 1 salt of tartar. After melting, quenching, and drying, one is to mix this with an equal weight of red lead, and melt and wash as before.

Melt No. 5 is the masterpiece. Our technologist of Bourbon France, names it "Mayence," because in that city lived a doctor, who supplied him with funds for his work. "One of the most beautiful compositions that one knows," he calls it, with rather a want of restraint in one so careful and painstaking. Having melted 3 parts of salt of tartar and 1 part of rock crystal ("prepared"), he dissolves the product in hot water, transfers to a stone jug, and adds nitric acid until the mass no longer swells. Then he washes with water until "it has no more taste," and dries the product. We suspect that this represents very pure silica.

Now he adds 1½ parts of very pure white lead, and mixes to a paste on a stone slab, using distilled water. To 1½ parts of this, after drying, he adds 2 *lots* of calcined borax, mixes in a marble mortar, melts and quenches. Then he adds to the fragments of frit, 1/12 saltpeter. Upon melting this new mixture he finds in the crucible "a very beautiful crystal glass of much fire." He deserved to find it.

"By one *part* one must understand one *mark* or 16 *lots* [1 *lot* = 10 grains] to so much [glass] one adds 3 grains of *Braunstein* [manganese dioxide] . . . If I do not take this precaution, it comes to pass, that certain colors change in an unusual manner."

The chapter closes with directions for making "a very beautiful white stone":

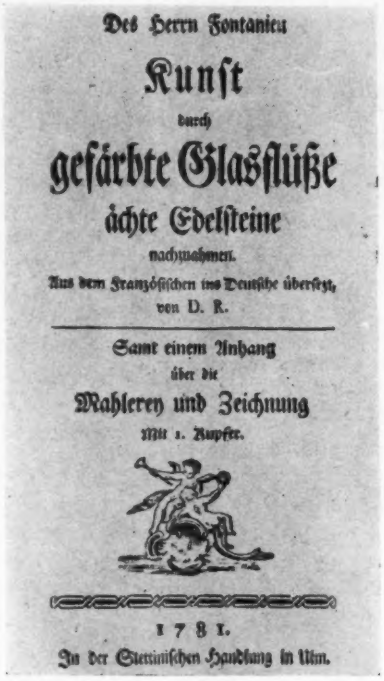
White Lead	16 *lots*
Prepared Rock Crystal	6 "
Powdered Borax	4 "
Manganese	½ grain

This mixture, he says, melted and quenched, produces the "beautiful white glass."

Remarking that the colors of artificial gems are due to the metallic calces which they contain. Fontanieu now begins to set forth recipes for making these gems. He first shows how to make Purple of Cassius, with directions for aqua regia, etc. He precipitates "horn-silver" in orthodox fashion, by means of salt, from nitric acid solution. This is to make a "yellow diamond," by adding 25 grains of horn-silver to one ounce of melt (4).

Copper-calx, he states, makes glass green; but if the copper is not completely calcined, a brownish red. Evidently "cupric" and "cuprous" were unknown terms then, but there were gropings! Papis lazuli, verdigris, and the residue from its distillation, are his sources of copper preparations, for making artificial emerald. Sometimes a dash of "kobolt" calx assists his color-formation.

He recognizes several calces of iron, and explains the origin of each. The magnetic oxide—duly roasted—serves in a curious mixture for opal: 2 ounces glass, 2 grains "magnet," 10 grains horn-silver, ½ grain mineral purple, ½ grain calcined bone ash.


Des Herrn Fontanieu
Kunſt
durch
gefärbte Glasflüße
ächte Edelſteine
nachzuahmen.
Aus dem Franzöſiſchen ins Deutſche überſetzt,
von D. R.
Samt einem Anhang
über die
Mahlerey und Zeichnung
Mit 1. Kupfer.
1781.
In der Gleditſchiſchen Handlung in Ulm.

TITLE PAGE OF FONTANIEU'S WORK, AS PRINTED IN THE GERMAN OF D. R.

Cobalt is used for blue, but Fontanieu is bothered by iron and bismuth as impurities. First roasting the arsenic from the cobalt ore, he places the calx in a retort with sal-ammoniac, and applies heat. Iron and bismuth sublime with the sal-ammoniac, leaving the pure cobalt calx. It is used in the artificial sapphire.

Obsidian is imitated by coloring a frit with cobalt, iron, and manganese, 2 ounces each in 1½ pounds. Tin "ash" produces a white glass, but he claims for antimony a reddish or hyacinth-colored product, in case the "half-metal" is not completely calcined. By using "glass of antimony," with a frit, he imitates oriental topaz.

Manganese is recognized as giving a violet color, up to black, as well as serving to remove color. A "fusible" manganese is described, which would seem to be identical with potassium permanganate.

It would serve no real purpose to give further details of this old piece of work. Enough has been quoted to show how traditional and empirical many of our glass-coloring processes are. We are greatly indebted to toilers like Fontanieu.

Pittsburgh Branch Election

At a recent meeting in Pittsburgh of the local section of the American Ceramic Society, officers were elected as follows: P. D. Helser, chairman, R. F. Ferguson, vice-chairman, A. C. Boyd, secretary, Jack H. Waggoner, treasurer, E. Ward Tillotson, Counsellor.

Economics of Producer Gas, Fuel Oil and Natural Gas Compared

(IN 5 PARTS)

by JOHN W. ROMIG, M. E.
Corning Glass Works

Part III.

Analysis of Fuel Oil as Tank Fuel

THE general aspects of the problem discussed in Part I and Part II covered the "Analysis of Producer Gas as Tank Fuel." The comparisons are all made for a regenerative continuous glass tank. It is assumed that the normal fuel used for firing is producer gas and that the tank is designed for low heat value gas rather than fuel oil or high heat content fuel gas.

Fuel oil is best applied to a multiple port tank by firing through burner blocks located in the port arches or cover blocks, with a burner for each port. Reversals in firing, first from one side for a period and then from the other side for an equal length of time are necessary to keep the checkerwork temperatures in balance. It is advisable to pass waste gases through the air and gas checkers when using fuel oil as gas checkers have a value as heat accumulators.

Steam in most cases has been more satisfactory than compressed air or mechanical devices for atomization and calculations are made using steam as the atomizing medium. A very satisfactory method of arranging the control is to place steam and oil headers on each side of the tank, set the values on individual burners and when reversals are made it is only necessary to close and open main header valve and make occasional adjustments. This arrangement enables a teaser to reverse with a minimum loss of time.

Data necessary to accumulate for investigating fuel oil as a tank fuel is shown below. Tank temperature (2,600 F.), air preheat temperature (2,300 F.) are assumed to be the same as for producer gas. It is possible to secure complete combustion with fuel oil using 30 per cent or less excess air and this value is used in the calculations for fuel oil heat deliveries.

ULTIMATE ANALYSIS OF FUEL OIL

Carbon 85.6% by weight.
Hydrogen 12.0% by weight.
Nitrogen .2% by weight.
Sulphur .4% by weight.
Oxygen .6% by weight.
Residue and ash balance by weight.
B.T.U. per pound = 20,000.

Weight 18 Baumé and the specific gravity .947 when referred to water.

Pounds per gallon=7.05.

Specific heat fuel oil = .6 B.T.U. per lb. per degree F.

Steam required = .3 pounds per pound of oil.

Heat content of 1 lb. steam above 60 F. = 1,132 B.T.U. or heat content of .3 pound = 377. B.T.U. above 60 F.

The heat entering the tank in the atomizing steam amounts to 377 B.T.U. per pound of oil and 377 × 7.05 or 2,660 B.T.U. per gallon of oil. The oil is assumed to be at 100 F. and the sensible heat in the oil amounts to .6 × (160—60) or 60 B.T.U. per pound or 420 B.T.U. per gallon. The specific heat of the oil being assumed as .6 that of water per degree F. temperature rise.

Air required for combustion is calculated from the analysis of the oil using the formula:

$$\text{Pounds air per pound fuel oil} = .116\ C + .345\ [H - O/8] + .43 \times S$$

where

C = percent carbon by weight.
H = percent hydrogen by weight.
O = percent oxygen by weight.
S = percent sulfur by weight.

Substituting in the formula and solving it is found that 14.22 pounds of air are required per pound of fuel oil for theoretical complete combustion. With 30 percent excess air the total air entering the tank ports from the regenerators will be 1.3 times 14.22 or 18.50 pounds per pound of fuel oil. As air has a volume of 13.06 cu. feet per pound at 60° F. the volume of air entering is 242 cubic feet and of this the excess air volume is 56 cubic feet per pound of fuel oil. On a gallon basis, the total air entering the checkers is 242 × 7.05 or 1,710 cubic feet per gallon of fuel oil and of this 56 × 7.05 or 395 cubic feet per gallon of fuel oil is excess air.

One cubic foot of air entering the tank at 2300 F. has a sensible heat content of 46.2 B.T.U. above 60 F. therefore the air entering with 1 gallon of fuel oil contains 1710 × 46.2 or 79000. B.T.U. including the heat brought in by the excess air. Interesting calculations may be made as a corallaries to the above to study the effects of variations of excess air percentages and attendant variations in loses of heat.

The waste gases per pound of fuel oil are calculated from the proportions of chemical combination and the analysis of the oil. Sulphur may be considered as carbon to simplify the calculation without introducing appreciable errors.

Constituent	Combining proportion	Fuel oil analysis percent	Wt. and consti.	Vol. const. per lb.	Vol. const. in waste gases per lb. oil
Carbon and sulfur	44 to 12	86.	3.15 CO_2	8.60 CO_2	27.0 CO_2
Hydrogen .	36 to 4	12.	1.08 H_2O	21.00 H_2O	22.65 H_2O
N_2 in fuel oil	..	.5	.005	13.46	.067
Excess air..	..	....	....	.....	56
Pounds N_2 from air theoretical combination	..	....	....	.....	147
H_2 from steam	..	....	.3	21.00	6.3

242 — 56 = 186 cu. ft. air for theoretical combustion of this .792% by volume is N_2 or 147 cu. ft. N_2 accompanies the oxygen required for combustion and total $N_2 = 242 \times .792$ or 192 cu. ft. per pound of fuel oil. The volume of oxygen in the waste gases per pound of fuel is $56 \times .208$ or 11.7 cubic feet.

Combining the volumes of waste gases the sensible heat in them is:

Constituent	Vol. per pound oil	Heat in 1.cu. ft. constituent @ 2600 F.	Heat per 1 lb. fuel oil in waste gases above 60F.
CO_2	27.0	90.6	2450
H_2O	28.95	77	2220
O_2	11.7	54	600
N_2	192	54	10400
Total			—15670. B.T.U. per pound fuel oil.

The dry waste gas analysis from the fuel oil with 50% excess air is as tabulated below:

FUEL OIL WASTE GAS ANALYSIS

Constituent	Volume per pound fuel oil	Percent by volume dry waste gas.
CO_2	27.0	11.8
O_2	11.7	5.2
N_2	192.	83.0
Total	230.7	100.00
H_2O	28.95	.....

Heat in waste gases per gallon of fuel oil equals 15,670 × 7.05 or 110,000 B.T.U.

One pound of fuel oil has 20,000 B.T.U. by analysis or one gallon has 20,000 × 7.05 or 141,000 B.T.U. chemically bound which are released in the combustion chamber.

Summarizing the heat entering and the heat leaving the tank per gallon of fuel:

Heat entering in atomizing steam.....	2,660	B.T.U.
Heating entering in fuel oil (sensible)...	420	"
Heat entering in fuel oil (chemical).....141,000		"
Heat entering in air (theoretical plus excess air)	79,000	"
Total Heat.....223,080		B.T.U.
Heat leaving with waste gases.....110,000		B.T.U.
Net useful heat in tank per gallon of oil.....113,080		B.T.U.

Sometimes compressed air is used for atomizing fuel oil. In such cases allowances must be made accordingly. If mechanical atomization is employed the calculations are altered only in regard to those items in which atomizing steam enters, although a small power item may add to the total cost per gallon of oil. A study of operation using the above method will show losses if steam quantities for atomization increase as careless use of steam carries more heat from the tank.

Decreasing the volume of a combustion chamber improves fuel oil economics over that shown. However the advantages of smaller chambers are not covered herein, it being assumed that the tanks are designed for producer gas and that design changes are not desired for if fuel oil is adopted as a fuel a change in fuel oil price may throw the economics in favor of producer gas.

Low gravity (Baumé) fuel oil with its accompanying higher B.T.U. per gallon contains more available heat per purchasing unit than the higher gravity fuel oils. It is therefore an important consideration to select fuel oil with this fact in mind. As a rule low gravity fuel oils are lower in first cost gallon for gallon than the higher gravity fuel oils. Atomization with heavy fuel oils becomes difficult if the oil is not heated and in the case of some the free carbon, moisture and residue contents are so high that clean combustion is impossible. With dirty fuel oil the centrifugal separator may become a necessity for securing proper flame cleanliness.

Part IV covers the discussion and calculations for natural gas as a tank fuel. In Part V is the actual comparison of the economics of producer gas, fuel oil and natural gas. The appendix following Part V gives useful formula for calculating fuel economics under varying temperature conditions.

Flow of Glass in Tanks

At a meeting of the London Section of the Society of Glass Technology held at the Osram G. E. C. Glass Works, North Wembley, early last November, members first had an opportunity of going round the works and of seeing in operation the Danner tube-drawing plant. This was followed by a discussion held in the library of the Research Laboratories, on "The Flow of Glass in Tanks." Mr. W. W. Warren presided and the discussion was opened by Mr. A. L. Marden who described a series of most interesting investigations on the flow of glass in the tank of the tube-drawing plant. These investigations have resulted in various improvements in the construction of the tank which were described in detail and illustrated by lantern slides. The relation between certain faults in the tubing produced which had occurred from time to time and the conditions of flow in the tank was convincingly demonstrated, and it was shown how the practical application of this knowledge had led to improvement in production.

Mr. Marden's remarks opened up a stimulating discussion in which a considerable number of those present took part and was only terminated by anxiety not to miss the last train home. The discussion was an excellent example of the willingness of those engaged in the industry to pool their knowledge and discuss frankly and without reserve the technical problems involved.

Colonel S. C. Halse moved a vote of thanks to Mr. Marden and Mr. Warren and coupled with it an appreciation of the hospitality afforded by the General Electric Company. This received hearty support from all present.

Effect of Light Rays on Man to Be Studied

The Smithsonian Institution at Washington has now under way plans for experiments with relation of the sun and artificial rays to the field of human ailments, according to a statement by the Director, Dr. C. G. Abbot. Numerous sanitariums are emphasizing the benefit of ray-therapy and ultraviolet rays, says Dr. Abbot. In discussing the effects of sunlight on health he said that a recently advanced theory attributed increased disability in winter months to decrease of vitamin properties in dairy products presumably due to dairy feed lacking properties absorbed from the sun by summer cattle food. Much more information on the subject is needed he said, and the Institution hopes to provide it.

The Permeability of Glass to ultraviolet light*

by GOTTFRIED ROSE
Dipl. Engr., Altenfeld (Thuringia)

(Concluded from the December, 1929, issue)

AS already mentioned, the reducing melt is very important in the preparation of ultraviolet glasses. The addition of stannous chloride as a reducing agent is restricted in this action, as is shown by melts S_2 to S_8. The increase in the ultraviolet permeability is only approximately proportional to the reducing agent added. This is the case in S_2 to S_4. S_5 shows to some extent the recognized effect of stannic acid, which has been used in rather large amounts in glass melting, giving a slightly clouded glass. But there is a limit to the permissible addition of stannous chloride for reducing the iron. In S_6, S_7 and S_8 there is even a slight decrease in the ultraviolet permeability with increasing stannic acid content. Here, even at 0.88% $SnCl_2$, there is the greatest reducing action while in the series S_2, S_3, S_4, and S_5 this was the case only at 2.6%. The reason for this is found in the larger total iron content in melts S_1 to S_5. The most suitable percentage of reducing agent to be added must therefore be adapted to the total iron content.

Another question is: Will the ratio FeO: Fe_2O_3 in the glass be displaced toward divalent iron by the reducing agent and the reducing melt, remain constant, or be displaced toward Fe_2O_3.

With aqueous ferrous salt solution we know that on exposure to air the ferrous salt gradually changes to ferric salt. Nothing similar to this could be expected in advance in glasses containing ferrous oxide. I came across this question due to the fact that it had been observed in America[18], that the ultraviolet permeability of glass decreases considerably on continued radiation with ultraviolet light.

I made experiments on this with a German commercial ultraviolet glass, with sanalux glass. For this purpose I cut a sample of this glass into five pieces and exposed four of them to the radiation of a quartz mercury lamp, placing them at equal distances from the lamp, about 30 cm. I exposed one piece for two hours, and the second 6 hours, the third 20 hours and the fourth 30 hours. Observed externally, the exposed glass samples after radiation showed a more yellowish-green color instead of the bluish-green color which it had previously.

The samples were tested spectrographically, as follows:

μμ	Unexposed	After 2 hours	After 6 hours	After 20 hours	After 30 hours
340	91.0	89.0	87.0	84.5	84.5
334	88.5	86.5	84.0	82.0	82.0
312	73.5	71.0	68.0	65.0	65.0
302	62.5	60.0	57.0	54.0	54.0
297	56.0	50.0	47.5	45.0	45.0
294	50.0	40.0	35.0	30.0	30.0
289	42.5	37.5	32.0	25.0	25.0
285	35.0	30.0	25.0	20.0	20.0
280	20.0	15.0	12.5	11.0	11.0
275	10.0	—	—	—	—
270	5.0	3.5	2.5	—	—
265	2.0	1.5	0.5	—	—

*Translation from Sprechsaal, 1929, v. 62, p. 352.
[18]Technical News Bulletin of the Bureau of Standards, Washington, D. C. 1927, Nr. 126.

After we consider the picture of these new curves (figure 12) we can immediately see very plainly the bulge characteristic of trivalent iron in the shape of the curves for the radiated glasses.

I shall now combine these factors:

The change in color of the glass during exposure, the observation made by Heinrichs that glasses high in ferrous iron appear bluish-green and those high in ferric iron appear yellowish-green.

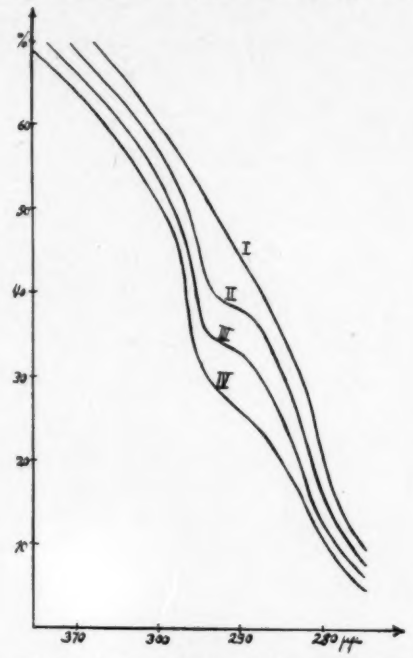


FIG. 12. The drop in ultraviolet permeability of Sanalux glass after radiation with ultraviolet light.
I. Unexposed glass. II. After 2 hours' exposure.
III. After 6 hours' exposure. IV. After 20 hours' exposure.

Further, the characteristic bulge in the shape of the absorption curves of the glass exposed to ultraviolet light, caused by the exposure.

From this, I concluded that the drop in ultraviolet permeability should actually be due to a re-oxidation of the divalent iron.

This phenomenon extraordinary in itself, has an analogy in the observation on the coloration of glasses containing manganese. It has been observed in these glasses that many window-panes which had been exposed to sunlight for years, gradually turned violet. It was attempted to explain the change in color by the assumption that the colorless manganous oxide contained in the glass had been changed to manganic oxide. Proof of this was furnished by the fact that greenish window glass, only incompletely decolorized, had been bleached by sunlight.

In addition to what has just been said, there is another explanation for the color change in this glass. It was be-

lieved that the change in color might have been caused by a separation of extremely finely divided sodium. This second explanation is based on the observed blue coloration of common salt on exposure to cathode rays or radium emanation. Observed under the ultramicroscope, common salt treated in this manner seems to be impregnated with extremely finely divided sodium particles. Further, it showed that the violet color of the glass appeared after a very short time, under the influence of cathode rays and radium emanation.

However, Fischer[19] showed that this coloration appeared only in glasses with a detectable amount of manganese; and this latter observation should doubtless support the first explanation, the formation of manganic oxide.

Another experiment that also might possibly support the explanation of the decrease in ultraviolet permeability by re-oxidation of the iron salt is as follows:

As we saw previously, the permeability of aqueous solutions of ferrous salt decreases considerably in the air. This decrease in ultraviolet permeability is much greater if the solutions are exposed to ultraviolet light. For this purpose I used a slightly acid solution of Mohr's salt with a FeO content of 1.114 g/1, took 150 cc samples of it, poured them into Erlenmeyer flasks of S. I. neutral glass, which thus were about ¾ filled with liquid and ¼ filled with air, corked them and placed them about 30 cm from a quartz mercury lamp and tested the first solution, then the second solution after 22 hours, the third solution after 6 hours more, and the fourth solution after 4 hours more. All four solutions were then exposed to the effect of ultraviolet light for 2 more hours. A fifth solution made at the same time, was not exposed at all and was kept in a closet. The following table shows the drop in ultraviolet permeability of the solutions treated in this manner:

TABLE 6

The permeabilities of solutions of Mohr's salt radiated with a quartz mercury lamp. (*In %*)

I. Unradiated solution after 40 hours
II. Solution radiated 2 hours
III. Solution radiated 6 hours
IV. Solution radiated 12 hours
V. Solution radiated 34 hours

μμ	I	II	III	IV	V
378	82.5	82.5	82.0	80.0	80.0
365	81.0	81.0	80.0	77.5	77.5
360	—	—	—	76.5	76.5
355	77.5	77.5	77.5	75.0	75.0
340	67.5	62.0	60.0	50.0	45.0
334	60.0	55.0	50.0	45.0	40.0
312	40.0	40.0	35.0	25.0	17.5
302	—	—	—	22.5	15.0
297	—	—	—	—	—
293	—	—	—	—	—
289	35.0	35.0	30.0	—	—
280	35.0	35.0	30.0	—	—
275	35.0	35.0	26.0	22.5	15.0
265	25.0	25.0	20.0	20.0	10.0
257	15.0	15.0	14.0	10.0	5.0
254	11.0	10.0	10.0	7.5	4.0
248	6.5	6.0	6.0	4.5	—
240	5.0	5.0	4.0	3.0	—
238	4.5	4.5	4.0	2.0	—

Here also, we find the bend in the permeability curve characteristic of trivalent iron, and also an increased transformation of ferrous salt to ferric salt, which was caused by the ultraviolet radiation (figure 13).

It was possible to determine the ferric salt formed in these quantities, using the titanium chloride method. 100 cc of each solution was tested. The determination gave:

TABLE 7

I. 0.0220 g Fe_2O_3/1
II. 0.0225 g Fe_2O_3/1
III. 0.0261 g Fe_2O_3/1
IV. 0.0380 g Fe_2O_3/1
V. 0.0320 g Fe_2O_3/1

A further confirmation of the fact that the drop in ultraviolet permeability is due to re-oxidation of the iron, is given by the experiments made by Rüttenauer[20], the results of which appeared in *Sprechsaal* in June, 1928.

At the suggestion of Director Engels (Neue Glasindustrie-Gesellschaft) A. Rüttenauer investigated the drop in ultra-

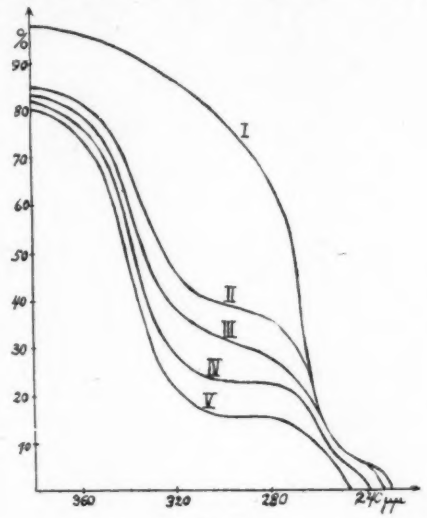


FIG. 13

violet permeability of glasses on radiation with quartz-mercury lamps. He observed that colorless glasses containing manganic oxide become violet in the light, and for this reason ultraviolet glasses were also studied. He further mentions the observation of the Bureau of Standards in Washington, which I also include as a basis in my discussion. Further, he mentions a French patent No. 618334/XIII/3, of the Corning Glass Works, U. S. A., in which the opinion is expressed that the drop in the ultraviolet permeability of a glass should be abscribed to re-oxidation of iron and titanium.

At the end of his comprehensive investigations on the decrease in the permeability of glasses, melted under reducing and oxidizing conditions, when exposed to ultraviolet radiation and higher temperatures, Rüttenauer gives the following summary:

"On intensive ultraviolet radiation all ultraviolet glasses decrease in permeability, and after a definite radiation time reach a limiting value for the permeability (see also the tests made by me, given in table 5, after exposure for 20 and 30 hours). The decrease in permeability becomes

[19]Fischer, Berichte der Deutschen Chemischen Gesellschaft 38, p. 946.

[20]Sprechsaal, 1928, Nr. 24 and 25.

greater as the wave length of the radiation becomes shorter. On the basis of investigations of glasses melted under reducing and oxidizing conditions, it can probably be stated that the decrease of the ultraviolet permeability depends on a re-oxidation of the iron. The ultraviolet permeability of the glass decreases at higher temperatures, and this is more strongly the case for short wave radiation than for long wave radiation."

This not unimportant drop in the ultraviolet permeability on radiation with ultraviolet light, might at first glance

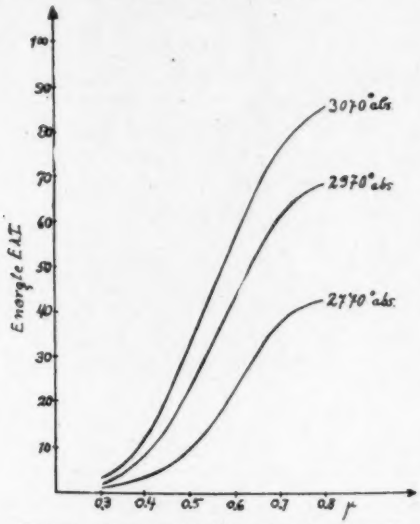


FIG. 14. Energy radiated by a tungsten filament.

make the use of window glass of durable good ultraviolet permeability seem doubtful; for it must be expected that, due to the ultraviolet rays in the sun, the permeability of the glass will be reduced. This is actually the case, but the decrease is considerably less because of the low intensity of the ultraviolet radiation in the sun, so that according to Peemöller[21] there is a decrease of 2 to 5% after several months, and then the permeability remains constant. The price is the principal obstacle to the general introduction of ultraviolet glass as window glass at the present day. Naturally, because the raw materials must be free from iron, this glass costs more, and in addition, the cost of melting is higher. Prices at the present time [1929] are as follows:

Ordinary window glass, blown or drawn 2 mm thick: 3.75 M per sq. m.
Sendl. glass, blown, 2 mm thick: 9.00 to 19.0 M per sq. m.
Sendl. glass, cast, 2 mm thick: 5.50 M per sq. m.
Ultraviolet glass, blown, 2 m thick: 8.75 to 12.5 M per sq. m.
Ultraviolet glass, cast, 2 mm thick: about half.

VIII. Incandescent Lamp Bulbs Permeable to Ultraviolet and Their Importance in Medicine.

Another very important field of application for ultraviolet glasses, which probably will be very important in the future, is the use of ultraviolet glass in illumination. The incandescent lamp bulbs that have been used up to the present time have generally been made of lead glass, and as we have seen from the table compiled by Zschimmer, lead oxide transmits very little ultraviolet light.

With the new ultraviolet glasses it is now possible to utilize the ultraviolet rays from our ordinary sources of light. The emission of ultraviolet light by tungsten filaments which are most generally used, is rather low as compared to the amount of light of greater wave lengths. The drop in the emitted energy at the lower wave lengths is shown in the following curves which have been made by Gehloff[22] for tungsten wire (figure 14).

The ratio of ultraviolet energy to the total energy is better if we consider only the sensitivity region of the unsensitized silver bromide plate.

The ultraviolet energy of different spectral regions in relation to the total visible energy is shown in the following table:

TABLE 8

Temp. abs.	$E\frac{0.35—0.4\ \mu}{0.4—0.8\ \mu}$	$E\frac{0.30—0.35\ \mu}{0.4—0.8\ \mu}$
2770°	0.90%	0.24%
2970	1.37%	0.37%
3070	1.60%	0.42%

TABLE 9

Temp. abs.	$E\frac{0.35—0.4\ \mu}{0.4—0.8\ \mu}$	$E\frac{0.30—0.35\ \mu}{0.4—0.8\ \mu}$
2770°	13.4%	3.5%
2970	16.2%	4.4%
3070	17.1%	4.5%

Some measurements were made by Fleischer (Physikalisches Institut der T.-H Dresden) in the region from 400 $\mu\mu$ down, which is of particular interest to us. The intensity of the photoelectric current was measured with a potassium cell, using a tungsten filament in a lamp with a quartz window. The results were as follows:

TABLE 10

Radiation measurements on electric lights with tungsten filaments.
(Photoelectric photometric method.)

I. Lamp with ordinary glass.
II. Lamp with glass permeable to ultraviolet.
III. Lamp with quartz window.

Wave length in $\mu\mu$	Photoelectric current in scale divisions		
	Lamp I	Lamp II	Lamp III
436	97	97	97
407	26	48	50
365	1	5	7
313	—	1	2
302	—	1	2

In order to be able to compare the steepness of the drop in radiation intensity of the three lamps at the short wave lengths, the photoelectric electron emission of the three lamps was made equal for the wave length 436 $\mu\mu$. The steepness of the curves gives us an indication of the different ultraviolet permeabilities of the three lamps. From 365 $\mu\mu$ down, the ultraviolet radiation of tungsten is very slight (figures 15 and 16).

In order to determine the permeability and practicability of ultraviolet glass as an incandescent lamp bulb, I had the Sophienhütte-Ilmenau Glass Works make some bulbs with the sample of Brevos glass. 25-watt lamps were made. Their

[21] Peemöller, Sprechsaal, 1928, Nr. 45, p. 894.

[22] Salmony, Der Werksleiter, 1928, p. 505.

permeability to ultraviolet radiation is compared with an ordinary 25-watt Osram lamp (lamp I). The arrangement of the filament was the same in each lamp.

At first glance, the advantage derived from the ultraviolet glass seemed to be very slight, but when we consider the skin-tanning curves given in figure 1, and remember that the tanning-effectiveness of the wave length of 365 $\mu\mu$ is only about 1/1000 that of the most effective wave length of 297 $\mu\mu$, then we can not fail to see the importance of the new ultraviolet lamps as compared with the earlier lamps.

The 25-watt lamp is a rather weak lamp, and its effect

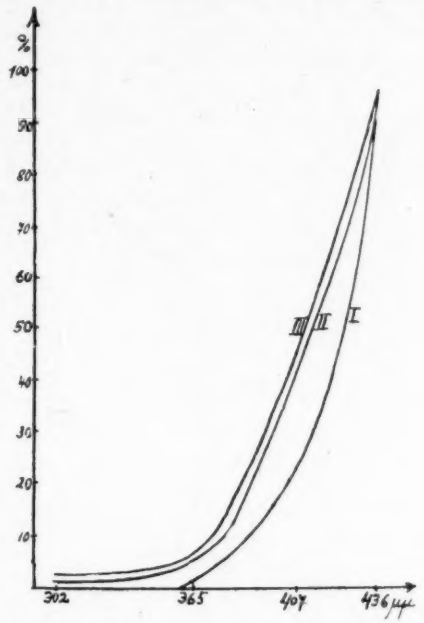


FIG. 15. Ultraviolet radiation measurements on incandescent lamps with tungsten filaments.
I. Ordinary incandescent lamp. II. Lamp with ultraviolet glass.
III. Lamp with quartz window.

on the skin is not noticed immediately. Recently, as Salmony-Berlin reports, the Osram works has made 300-watt and 500-watt lamps with ultraviolet glass, which causes a reddening and tanning of the skin in a comparatively short time just like sunlight. The total radiation of these lamps was measured with a thermocouple, the ultraviolet radiation with a cadmium cell and both measurements were compared with measurements on the sun in mid-summer. It was found that if the thermocouple was placed 1½ meters from the lamp, and the ultraviolet radiation was measured with a cadmium cell at the same distance, the same deflection was obtained as with the sun.

With their spectrum which is similar to that of the sun, these lamps will find extensive use, particularly in medicine, because they can be connected to any ordinary light line as contrasted with the quartz mercury lamps previously used in therapy, which required direct current of a certain voltage. Further it is absolutely necessary that the use of quartz mercury lamps be supervised by a doctor because, due to their richness in very short-wave ultraviolet light, harm might easily be done by too long an exposure. In the new ultraviolet lamps, the shape of the emission curve for tungsten gives a better proportion of ultraviolet light. It will be the problem of medicine and hygiene to utilize this advance in the glass industry and to apply it to the welfare of mankind.

CONCLUSION

1. The permeability of a glass for ultraviolet light increases with decreasing ferric oxide content.

2. In addition to the total iron content, the state of oxidation of the iron is of very great importance for the ultraviolet permeability.

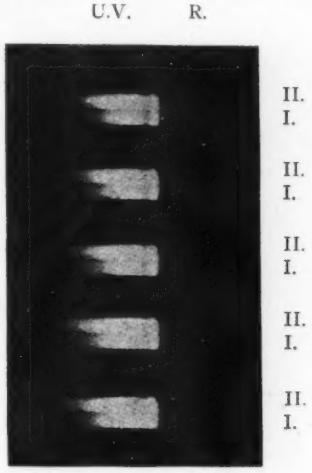


FIG. 16. Blackening of a photographic plate by lamps I and II.

3. Ferrous oxide absorbs less strongly than ferric oxide.

4. The ultraviolet absorption by trivalent iron in aqueous solution is about 100 times as great as the absorption by divalent iron.

5. The decrease in ultraviolet transmissive power under the influence of ultraviolet radiation, is due to a re-oxidation of the divalent iron.

6. The transformation of ferrous salt to ferric salt in aqueous solution is accelerated by radiation with ultraviolet light.

7. Using curves of ultraviolet permeability, it is possible to obtain an indication of the ratio of ferrous oxide to ferric oxide in glass with a low iron content, in which the methods for the determination of divalent and trivalent iron fail to give results.

Large Annual Awards for Scientists

The largest single monetary award in America for scientific accomplishment has been created by *Popular Science Monthly*, which, beginning this autumn, will confer an annual prize of $10,000, accompanied by a gold medal, upon the American citizen who has been responsible, during the preceding year, for the achievement in science of greatest potential value to the world.

It is explained that the award is intended to heighten the interest of the American people in those conquests of the laboratory and the workshop which benefit the entire community and to focus attention upon the many scientific workers who, without thought of personal profit, toil to better man's control over his physical surroundings.

The Popular Science Institute has enlisted twenty-four leaders in American science to serve as a Committee of Award. The distinguished men comprising the Committee of Award include the following members of the American Society of Mechanical Engineers: Prof. Collins P. Bliss, Dr. Harvey N. Davis, Charles F. Kettering, Dr. Arthur D. Little, Dr. Elmer A. Sperry, Dr. Samuel W. Stratton, Henry Herman Westinghouse, Dr. Albert E. White, and Orville Wright.

Glass Industry

ESTABLISED 1920

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YOU WILL GAIN
By Attending the Annual Meeting
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The American Ceramic Society
at The Royal York, Toronto, Canada
February 16 to 21

"Spend That You May Gain"

(Reprinted from an editorial in the December issue of the Bulletin of the American Ceramic Society.)

There must be a balance between our spending and our saving. To spend recklessly is foolhardy. To save in a miserly fashion is defeating.

A study of the rosters of the American Ceramic Society for the past thirty-two years reveals that those men who came regularly to meetings of this Society, often at their own expense, and who contributed to the programs are occupying high salaried positions.

Those firms that have permitted their men to contribute to the programs have not lost trade advantages. On the contrary, they have given opportunities to their men to develop, to acquire knowledge, and to be known as men who are alert and know their business, thereby increasing their abilities and resourcefulness.

Prestige of the employees is reflected in prestige of the products made.

This search of the Society's roster does not reveal a single firm that has handicapped itself or given manufacturing advantages to its competitors by contributing freely to the meeting programs. On the other hand those firms that have moved forward and are meeting the present high wage (low product price), high product quality demands, are those that have helped make successful the several means afforded by this Society for the development of ceramic men and of ceramic knowledge.

It has been proved that those firms that exchange ideas and knowledge freely and who visit each other's plants, assist one another in developing equipment and processes, and in every way give mutual assistance in producing the highest quality of ware at the lowest cost, have not altered their individual trade advantages or changed their relative status as competitors. . . .

One must spend to obtain benefits. There must be a balance between our spending and our saving and that balance is found in spending all that it costs to be among the folks who are accomplishing things worth while. It pays to attend the meetings of this Society, it pays to participate in the Ceramic Expositions, and it pays to put time, thought, and money into committee work. Spending on affairs of this sort pays handsome returns.

Rather than saving the cost of participation in the affairs of this Society one is actually paying a cost for not doing so. This cost shows in lessened abilities and more restricted visions and inspirations. A "live wire" knows that that portion of his earnings which is needed for participation in these activities draws a larger dividend than if all of his earnings are invested in banks and stocks. The more one spends in the affairs of this Society the more he will have for investment in business, social, and family affairs.

Correspondence

To the Editor of THE GLASS INDUSTRY:

I have been greatly interested in the series of papers on The Permeability of Glass to Ultraviolet Light, by Dr. Gottfried Rose, which have been published recently in THE GLASS INDUSTRY. My interest is more than academic, because I have had this glass

installed in the windows of my consulting room and in one of my living rooms, and I believe, the change has been more than justified.

My purpose in writing however, is not to extol ultraviolet glass, but to comment on the data furnished in Table 1, page 216. Reference to that table will show that the students from the class equipped with Vitaglass gained considerably more in weight, height and hemoglobin content in the nine months of the test than did the students in the control class.

There is no question in my mind but that these data are correct. It appears to me, however, that the conclusions based on these data are apt to be misleading because the test was not made under the most rigid circumstances. In the first place, it is evident that the children in the control class who weighed 60.04 lbs. on the average when the test was begun, were not as strong physically as the Vitaglass class, who weighed on the average 67.90 lbs. at the same time. The control class started out under a handicap of nearly 8 pounds in average weight. Secondly, as to height, the control class was 2.28 inches shorter than the Vitaglass class, to begin with; and lastly there was a handicap in the hemoglobin content of a little more than 1 per cent.

It is evident then that the control class was considerably inferior physically when the test was begun, and it would be quite natural to expect that these inferior children would not gain in height, weight and hemoglobin content under plain glass, as much as the heavier, taller and richer blooded children in the Vitaglass class. The point I am making is that the test should have been applied to two groups of children equal or approximately equal in the respect of height, weight and hemoglobin content. If one group then showed considerably more gain than the other group, the results would certainly have been more convincing. I trust you may be able to present such data in the future.

Sincerely yours

114 East 61st Street (*Signed*) ABR. L. WOLBARST, M. D.
New York.
January 20, 1930.

To the Editor of THE GLASS INDUSTRY:

We thank you for giving us the opportunity to answer the letter of Dr. Abr. L. Wolbarst dated January 20th.

We consider that Dr. Wolbarst's comments on the differences in weight and height are well taken though it appears to us that the difference in gain at the end of the test in favor of the boys in the Vita glass class over the control class, is greater than can be explained by the fact that the classes did not originally start with the same average weight.

Since the Smethwick School test in question, there have been a number of interesting developments and biological tests with the use of Vita glass; some of these are summarized as follows:

Test by Council on Physical Therapy, American Medical Association in Boston in January and February, 1927, on chickens. In this instance, the Vita glass chickens gained over twice as much in weight as did an equal group of control chickens under ordinary window glass and the Vita glass chickens were protected from rickets while all the control chickens had rickets.

Test by U. S. Army Medical Corps in Washington, D. C., December, 1927, to March, 1928, on white rats. The group of rats under Vita glass were protected from rickets while the control rats under ordinary window glass all had rickets and the Vita glass rats showed a marked gain in weight over the controls.

Similar results were obtained in a series of tests made on chickens at the Wisconsin University in the winter of 1927-28. In that instance the Vita glass chickens averaged 254½ grams in weight at the end of the test as against 217½ grams for the ordinary glass chickens.

While it is not practical to make a scientifically controlled test on humans because of the difficulty in controlling the outside conditions, there have been many instances were the use of Vita glass showed a marked reduction in illnesses and better gains in weight and general health. Among these is a test made with Vita glass in the winter of 1928 at the Birmingham Public School, Birmingham, Mich., covered in their annual report as follows:

"Careful tests were made of the children at the beginning and end of the experimental periods. They were weighed and measured each month. Attendance and absence were carefully kept. After considering all the factors it was found that the group in the ultraviolet room had a better academic record, a better attendance record and had gained more on the average in height and weight than did the control group."

The report of a very interesting test made at the Greets Green Infants' School in West Bromish, England, has just come to our attention. In that instance they took 40 pairs of average children and put one of each pair in the Vita glass class room and the other in a control room under ordinary glass, kept their weights, heights and attendance for six months; the Vita glass class showed a greater gain in average weight, height and attendance. Then they reversed the children and the classes evened up during the next six months in all three particulars. Copies of this test are available to anyone interested.

Very truly yours,

New York, VITAGLASS CORPORATION
January 24, 1930. (*Signed*) P. W. JENNINGS,
President.

The Society of Glass Technology

The last meeting of the Society of Glass Technology for the year 1929 was held in the Science Museum, London, on December 18, 1929, when the following three papers were presented and discussed.

(a) "The Choice of Annealing Schedule for Commercial Glassware." By J. B. Murgatroyd, B. A. (*A Communication from the Laboratory of the British Hartford-Fairmont Syndicate, Ltd., Greenford.*)

The two principal conditions governing the type of schedule to be chosen were (a) the composition of the glass, and (b) the amount of strain permissible in it, after being annealed. The composition of the glass controlled the annealing temperature and the annealing range. For the purpose of the investigation these terms were defined as follows. For annealing temperature, the definition of F. Twyman was accepted, namely, that temperature at which at least 95 per cent of the strain in glass was relieved in 3 minutes, the determination being made by the bending bar method. Annealing range was that range of temperature below the annealing temperature extending to the point where only 1 per cent of existing strain was removed in 3 minutes. A safe figure for the annealing range was 56°. In actual works practice larger ranges must be allowed in lehrs, even as much as 100°. The author then discussed the kind of temperature gradients allowable in cooling through the range. These were two possible conditions: (I) where the annealing temperature (as defined) was higher than the critical point where the expansion coefficient increased, and (II) where the annealing temperature was at or below this critical point.

It was not possible to state definitely the relative positions of the annealing temperature and critical temperature for expansion, but of several glasses examined it was found that the annealing temperature was 40° to 50° higher than the critical temperature. The problem was discussed mathematically and certain results obtained. For ordinary soda-lime-silica glassware, of an average thickness of 0.5 cm, the annealing schedule might be as follows:

15 minutes for the ware to become uniform and strain free at the annealing temperature.

10 minutes for the annealing range of 50° at 5° per minute.

There would then remain a range of about 450° over which an average rate of cooling of 10° to 15° could be maintained in most lehrs, requiring say 35 minutes. The most economical schedule for ordinary commercial glassware therefore required some 60 to 70 minutes. This had to be modified according to the thickness (L) of the ware as expressed in the approximate figure for the rate of cooling through the annealing range, i. e., $1.3°/L^2$ per minute, leaving 5 per cent of the breaking stress in the ware.

When discussing the amount of strain permissible in commercial glassware, the author stated that if it were possible so to control a lehr as to alter the rate of cooling and maintain uniformity of conditions, it would be possible to improve the resistance of ware both to thermal shock and internal pressure. Ware stressed in this way up to about 20 per cent of the breaking stress did not show any lessened resistance to mechanical shock and was certainly more resistant to the two tests mentioned. If this figure were chosen for the desired amount of stress in the annealed ware, it would change the rate of annealing as estimated from $1.3°/L^2$ per minute to $5.2°/L^2$ per minute, and this would give an allowable state of 21° per minute through the annealing range for ware 0.5 cm. in thickness. The amount of heat conducted from one wall to the other in glass was approximately 0.01 calories per second.

(b) "A Theory of the Strength of Thermally Toughened Glass." By Dr. J. T. Littleton, Jr., and Dr. F. W. Preston.

Glass that was poorly annealed, or that is deliberately "toughened" by chilling it from above the annealing range, was characterized by having its outer layers in compression and its inner layers in tension. Such poorly annealed or toughened glass might be stronger or weaker than well-annealed glass, according to circumstances. The glass became treacherously weak if any part of the interior zone of tension reached the surface and it was then likely to break spontaneously—hence some writers spoke of "negative hardening" and ascribed it to subtle changes of physical constitution. The author first of all discussed the nature of glass fracture. Flaws in the interior of a piece of glass would need twice as much effort to extend them as would a flaw at the surface. The interior of the glass would be twice as strong as the skin. On this fact depended the merit of "toughened" glass. There was an optimum heat treatment, producing an optimum initial strain, which was such that when the mechanical pull was applied, the limiting strength of the interior and of the surface was reached simultaneously. The optimum heat treatment for ordinary soda-lime glasses was one which introduced about 3,500 lbs. of axial tension, as in such glasses the breaking load was usually about 7,000 lbs. per sq. inch. This applied to rods under plain tension. The usual test however, was to take a lath of glass, to place it like a bridge over two supports near the ends, and to break it by bending. A mathematical discussion of this problem was then given, from which it appeared that, theoretically, the best possible heat treatment would be to make the glass about 3.4 times as strong as well-annealed glass. The question was considered next in the light of impact tests. The greatest cause of the breakage of glass was that it was hit. Under impact, two new sets of stresses appeared—vibrating stresses and a great concentration of bearing stresses at the point where the impact occurred. This might result in driving a "conical" hole through the glass, or in beginning to do so, whereon a general radiating system of cracks started in all directions. This problem was discussed and references made to experimental results obtained by L. T. Sherwood.

(c) "The Strength of Glass Containing Cracks." By Lowell H. Milligan. (*A Communication from the Norton Company Research Laboratories, Worcester, Mass., U. S. A.*)

Experiments were made to study the travel of cracks through glass. The general procedure was to cut small bars from a pane of window glass. A steel-wheel glass cutter was used to do this and also to mark the bars with a transverse scratch across the centre. Then the bars were subjected to atmospheres of different types, or were netted with various liquids, and the conditions of time and load under which they would break were studied. The nature of the scratches and the distribution of stress around them were determined by microscopic examinations with ordinary and with polarised light. The experiments showed that, 1. The presence of water in the crack reduced the strength by about 20 per cent. 2. Exposure in air saturated with water vapor reduced the strength considerably. Although the exact magnitude of this effect was not determined, it would seem to be similar to that produced by the liquid water. 3. Bars that were wetted and then redried before testing regained slightly more than their original dry strength. 4. Air saturated with the vapor of absolute alcohol produced an effect similar to that of air saturated with water vapor 5. The presence of dry paraffin oil in the crack increased the strength by about 20 per cent. 6. Wetting the crack with a dilute solution of sodium silicate followed by drying increased the strength by about 20 per cent. 7. The effect of water in decreasing the strength and of dry paraffin oil in increasing the strength, was practically instantaneous, and therefore these effects were thought to be physical rather than chemical in nature.

At the meeting held in the University, Leeds, on November 20, 1929, a general discussion took place on "The Function of Cullet in Glassmaking." The discussion was introduced by the two following papers, namely:

(a) "The Effect of Repeated Re-melting of Glass in Sillimanite and in Fireclay Pots." By A. A. Childs, Violet Dimbleby, M.Sc., H. W. Howes, M.S. Tech., and Professor W. E. S. Turner.

(b) "The Effect on some Physical Properties of Glass Repeatedly Melted in Platinum." By Violet Dimbleby, M.Sc., H. W. Howes, M.Sc. Tech., F. Winks, M.Sc. Tech., and Professor W. E. S. Turner.

Professor Turner dealt with the two papers together, as the work described in the second was the outcome of difficulties met with in the first investigation. In previous papers were described the effects of varying the proportions of batch and cullet in soda-lime-silica and in potash-lead oxide-silica glasses. The present investigations were undertaken in order to test the effect of repeated remeltings on the composition and working properties of the same glass originally made from batch. The first series of tests were conducted using a simple lime-soda-silica glass, made and remelted many times in a sillimanite pot. The glass made from batch was worked from the pot, broken up, returned to the pot, remelted, worked out again, and samples taken. The bulk was broken up, returned to the pot, remelted, worked out, and further samples taken. This procedure was repeated until samples had been obtained, each representing a definite number of remeltings of the same glass.

The amount of corrosion observed on the pot after the remeltings of cullet was astonishing, and was confirmed by the irregular, yet considerable percentage of ferric oxide and alumina found in the glasses on chemical analysis. A second series of glasses gave similar results. The compositions of the glasses were given in full and revealed a diminution in soda as the remeltings progressed, but it was not obvious, from simple inspection, whether this diminution in the alkali was due to actual loss or to change in the proportions of the constituents due to the absorption of material from the pot.

The glass worker reported a shortening of the working range, and an increase in brittleness of the glasses with each remelting. The glasses also became darker in color.

The absorption of a considerable quantity of pot material by the glasses vitiated all attempts to determine the effect of remelting alone on the physical properties of the glasses. A further series of remeltings using a harder glass was carried out in exactly the same manner in a fireclay pot, but this time the pot attack was greater than in the sillimanite pots, although the glass used was of lower soda content than in the earlier series. A series of annular depressions were formed in the pot walls corresponding to the level of the metal in the successive meltings. It was useless to employ these glasses for tests on working or physical properties.

A further investigation was, therefore, undertaken, glasses being made and remelted repeatedly in platinum to eliminate as far as possible, the corrosion of the vessel. Of necessity the amount of glass made was small. A very small amount of platinum was dissolved into the glass, but this was very minute and negligible for the purposes of this investigation. Two series of glasses were made as in the sillimanite pots, and it was found that three repeated meltings were necessary before these small melts were homogeneous. Accordingly a third set of remeltings were completed, the glass being crushed and remelted twice before any samples were taken for test. Seven samples were obtained, each representing a further remelting. The chemical compositions, the densities, annealing temperatures, and thermal expansions of the glasses were determined. It was found that the chemical compositions varied but slightly throughout the whole number of samples. There was a slight tendency to diminution of soda as the remelting proceeded, but the differences found were not appreciably greater than analytical error. Very little variation was found in the annealing temperatures, or the densities, or the thermal expansions of the glasses.

In conclusion, Professor Turner stated that so far as those properties examined were concerned, the remelting of a homogeneous glass did not effect any appreciable change. The cullet problem seemed to be a problem of diffusion, and if cullet were properly crushed and mixed intimately with the batch, then it should be possible even to employ "foreign" cullet within reasonable limits successfully.

Cryolite in Germany

According to Commercial Attache F. W. Allport, Berlin, Germany, as reported in *World Trade Notes*, artificial cryolite (sodium aluminum fluoride) is produced on a substantial scale in Germany. The natural product is imported to the extent of about 3,000 metric tons annually. A principal use for this production is as a solvent for aluminum oxide in the manufacture of aluminum.

Industrial Power-Factor Problems Solved By Scale

The General Electric Company has announced a new system of solving power factor problems. This is a graphic method involving simple computations only. In brief the new system consists of laying down to scale the known factors and then scaling the unknowns.

Industrial power-factor problems can be solved by scale without resorting to degrees or functions of angles, squares or square roots, "kw." or "kv-a." All that is needed is a scale, pencil, and paper. A right-angle triangle with the sides in proportion 3 to 4 to 5 and a small T-square will save time and make the work more accurate. A few typical problems are worked out here so that the principles may be readily understood and applied to other power-factor problems.

1. Draw horsepower as a horizontal line to a suitable scale as suggested in the following tabulation:

For 150 hp. or less,	let 1/16 in.	= 2	hp.
Up to 500 hp.,	let 1/16 in.	= 5	hp.
Up to 800 hp.,	let 1/16 in.	= 10	hp.
Up to 2000 hp.,	let 1/16 in.	= 25	hp.
Up to 8000 hp.,	let 1/16 in.	= 100	hp.

2. Lines slanting *upward* to the right represent *lagging* power-factor and their lengths are determined by dividing horsepower by lagging power-factor.

3. Lines slanting *downward* to the right represent *leading* power-factor and their lengths are determined by dividing horsepower by leading power factor.

4. Horsepower at unity power-factor will be represented by horizontal lines.

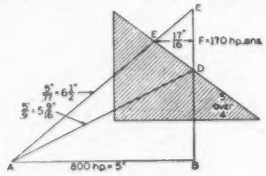
Use the G-E triangle or cut a right-angle triangle from cardboard with 3-in., 4-in., and 5-in. sides (the carpenters' old 3-4-5 way of laying out a square corner). Using the 5-in. side over the 4-in. side gives the correct slant (rule 3) for 0.8 power-factor.

Decimal Equivalents of Fractions of an Inch

Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal
1/64	.0313	9/32	.2813	17/32	.5313	25/32	.7813
1/32	.0625	5/16	.3125	9/16	.5625	13/16	.8125
3/64	.0938	11/32	.3438	19/32	.5938	27/32	.8438
1/16	.1250	3/8	.3750	5/8	.6250	7/8	.8750
5/64	.1563	13/32	.4063	21/32	.6563	29/32	.9063
3/32	.1875	7/16	.4375	11/16	.6875	15/16	.9375
7/64	.2188	15/32	.4688	23/32	.7188	31/32	.9688
1/4	.2500	1/2	.5000	3/4	.7500	1	1.0000

Problem 1. Given: an 800-horsepower load at 0.77 power-factor. How much horsepower in 0.8-leading-power-factor synchronous motors must be substituted to raise the power-factor to 0.9?

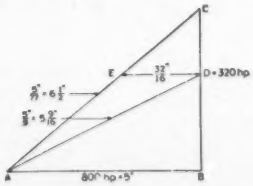
Solution: use scale 1/16 in. = 10 horespower. Draw 80/16 in.



PROBLEM 1

(5-in.) horizontal line AB and a vertical line at B. Divide 5 in. by 0.77 = 6½ in. In the vertical line, determine a point, C, 6½ in. from A, and connect C with A. Divide 5 in. by 0.9 = 5 5/16 in. Determine a point, D, on the vertical line 5 5/16 in. from A and connect D with A. Apply the 0.8-leading-power-factor slant of the triangle at D and draw DE. Measure the horizontal distance EF = 17/16 in. or 170 horsepower, answer.

Problem 2. Given: an 800-horsepower load at 0.77 lagging power-factor. How much horsepower in unity-power-factor synchronous motors must be substituted to raise the power-factor to 0.9?

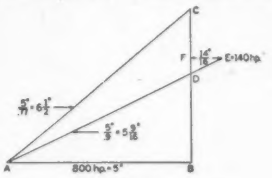


PROBLEM 2

Solution: draw the base line, the vertical, and the two lagging-power-factor slants as for Problem 1 (or use the same diagram). Draw a horizontal line from D to AC at E. Measure DE = 32/16 in. or 320 horsepower, answer.

Problem 3. Assume that an 800-horsepower load at 0.77 lagging power-factor has been raised to 0.9 lagging power-factor. How much horsepower can be added without increasing the original system heating?

Solution: draw the base, the vertical, and two lagging power-

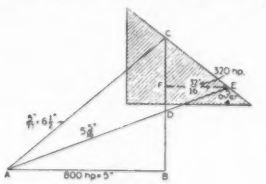


PROBLEM 3

factor slants as for Problem 1, but extend AD to E so that AE is 6½ in. long (the same as AC). Measure the horizontal distance EF = 14/16 in. or 140 horsepower, answer.

Problem 4. Given: an 800-horsepower load at 0.77 lagging power-factor. What power-factor will result if 320 horsepower in 0.8-leading-power-factor synchronous motors is added?

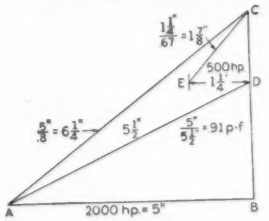
Solution: draw base, vertical, and 0.77 power-factor slant as for



PROBLEM 4

Problem 1. From C, draw an 0.8-leading-power-factor slant, determine a point, E, on it 32/16 in. (320 hp.) from the vertical, and draw a horizontal line, EF. Draw ADE: Measure AD = 5 5/16 in. Divide 5 in. by 5 5/16 in. = 0.94 power-factor, answer.

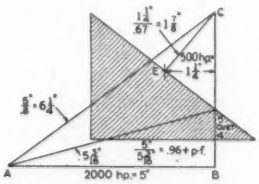
Problem 5. Given a 2000-horsepower load at 0.8 lagging power-factor in which one 500-horsepower group of motors has a 0.67 lagging power-factor. What power-factor would result if (a) unity-power-factor synchronous motors were substituted for this



PROBLEM 5a

group, and what if (b) 0.8-leading-power-factor synchronous motors were substituted?

Solution: choose a scale of 1/16 in. = 25 hp. Draw AB 80/16



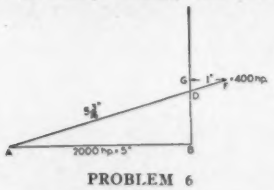
PROBLEM 5b

in. (5 in.), and vertical at B. Divide 5 in. by 0.8 = 6¼ in. Determine a point, C, on the vertical 6¼ in. from A and connect A with C. Draw a line parallel to, and 1¼ in. (500 hp.) from,

BC. Divide 1¼ in. by 0.67 = 1⅞ in. In the last-drawn line, determine a point, *E*, 1⅞ in. from *C* and draw *CE*. For solution of (a), draw the horizontal *ED* connecting *E* with *BC*. Measure *AD* = 5½ in. Divide 5 in. by 5½ = 0.91 power-factor, answer. For the solution of (b), proceed as in (a), but draw an 0.8-leading-power-factor slant from *E* down through the vertical at *D*. Measure *AD* 5⅜ in. Divide 5 in. by 5⅜ = 0.96 power-factor, answer.

Problem 6. Under the conditions in Problem 5b, how much load can be added without increasing the original system heating?

Solution: draw the base, vertical, and 5⅜-in.-lagging-power-

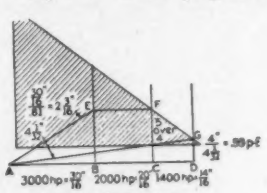


PROBLEM 6

factor slant *AD* as for Problem 5b and extend *AD* to *F* 6¼ in. to equal *AC*. Measure the horizontal *FG*, 1 in. or 400 hp., answer.

Problem 7. Given: 3000 horsepower at 0.81 power-factor and 2000 horsepower in unity-power-factor synchronous motors. What will be the system power-factor if the remaining 1400 horsepower is in 0.8-leading-power-factor synchronous motors?

Solution: total horsepower 3000, plus 2000, plus 1400 = 6400. Use a scale of 1/16 in. = 100 hp. Draw a base line *AD*, 4 in. long, to represent 6400 horsepower. Draw perpendiculars at *B*, 30/16

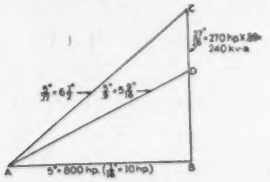


PROBLEM 7

in. from *A*; at *C*, 20/16 in. from *B*; and at *D*. Divide 30/16 in. by 0.81 = 2⅜ in. Determine a point, *E*, on the perpendicular over *B* and 2⅜ in. from *A*, and draw *AE*. Draw a horizontal (unity-power-factor) line *EF* to the perpendicular over *C*. Draw an 0.8-leading-power-factor slant from *FG* down through the perpendicular over *D*. Draw *AG*; it measures 4 3/32 in. Divide 4in. by 4 3/32 = 0.99 power-factor, answer.

Problem 8. Given: an 800 horsepower load at 0.77 power-factor. What size of synchronous condenser or capacitor would be required to raise the power-factor to 0.9?

Solution: draw the base, perpendicular, and the two lagging-

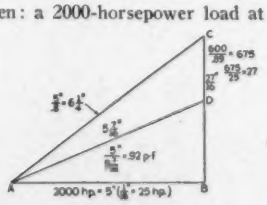


PROBLEM 8

power-factor slants as in Problem 1. Measure *CD* 27/16 in. = 270 hp. Multiply by 0.89* = 240 kv-a., answer.

*(Assumed motor efficiency, 84% i.e. 0.746/0.84 = 0.89).

Problem 9. Given: a 2000-horsepower load at 0.8 power-factor.



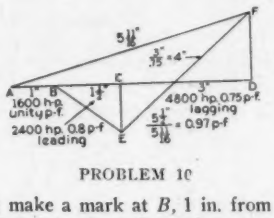
PROBLEM 9

What will be the effect of connecting 600 kv-a. of synchronous condensers or capacitors?

Solution: choose a scale of 1/16 in. = 25 hp. Draw a base line *AB*, 5 in. long, and a perpendicular at *B*. Divide 5 in. by 0.8 = 6¼ in. Determine a point, *C*, on the perpendicular 6¼ in. from *A* and draw *AC*. Divide 600 by 0.89 (see Problem 8) = 675. Divide 675 by 25 (the scale) = 27/16 in. Measure down *BC* 27/16 in. from *C* and establish point, *D*. Draw *AD*; it measures 5 7/16 in. Five inches divided by 5 7/16 = 0.92 power-factor, answer.

Problem 10. Given: 1600 horsepower in unity-power-factor load, 2400 horsepower in 0.8-leading-power-factor load, and 4800 horsepower in 0.75-lagging-power-factor load. What will be the system power-factor?

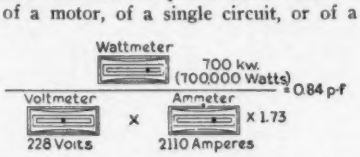
Solution: choose a scale of 100 hp. = 1/16 in. Draw a base line



PROBLEM 10

AD, 5½ in. long; make a mark at *B*, 1 in. from *A*; a perpendicular down from *C*, 1½ in. from B; and a perpendicular up from *D*. From B, draw an 0.8-leading-power-factor slant intersecting the perpendicular drawn from *C* at point *E*. Divide 3 in. by 0.75 = 4 in. Draw a line *EF* 4 in. long to the perpendicular over *D*. Draw and measure AF (5 11/16 in.). Divide 5½ in. (total load) by 5 11/16 = 0.97 power-factor, answer.

Note: Where there is no power-factor meter installed, the power-factor of a motor, of a single circuit, or of a whole plant



can be found from the reading of a wattmeter, a voltmeter, and an ammeter. G-E portable meters are useful for analyzing plant power conditions.

For three-phase power, watts divided by (volts times amperes times 1.73) gives the power-factor. The process may be illustrated as at the right.

(*Copyright 1929 by General Electric Company.*)

Process of Making Abrasives Filmed

An educational motion picture entitled "Manufactured Abrasives" has been made available by the Bureau of Mines, Department of Commerce, Washington, D. C., for exhibition purposes by schools, churches, clubs, societies, etc. Copies may be obtained at the Pittsburgh Experiment Station of the U. S. Bureau of Mines, Pittsburgh, Pa. The only cost is for transportation charges. The film was made in cooperation with the Carborundum Company, Niagara Falls, N. Y., and includes scenes showing the American and Canadian falls and the turbulent rapids above the falls. A method of driving the electric generators which produce the tremendous power consumed in making the abrasives by the force of water plunging down immense pipes to turbines, and the operations of molding, pressing and drying of abrasive wheels are also shown.

Color Alone Not Eligible for Trade Mark

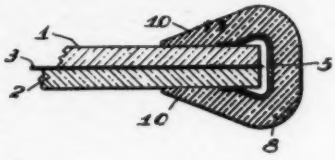
In the rehearing of a case before the Assistant Commissioner of Patents for registration of type having a red colored face, the application was denied on the ground that mere coloring of an article does not function as a trade mark and is not registrable. It is only when the color is impressed on some novel design such as a circle, star, cross, or other figure that it becomes registrable as a trade mark. In an opinion by Assistant Commissioner Moore it is stated that "it has been uniformly held that mere color does not function as a trade-mark as it directs the mind to the article and not to the origin or ownership of the article. It is only when color is impressed upon some arbitrary design, such as a circle, star, cross or other figure that the mark may be registrable."

Recent Patents

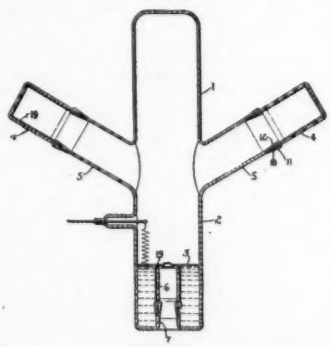
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

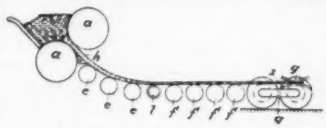
APPARATUS FOR MAKING COMPOSITE GLASS. U. S. 1,734,379. Nov. 5, 1929. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company. Filed 2/20/28. Apparatus for making composite glass wherein heat and pressure are applied to cause a joinder between the glass and celluloid [as in laminated windshield glass]. In carrying out the pressing operation, the assembled sheets are placed in a tank and hydraulic pressure is applied, heated liquid being used, so that the liquid as thus applied not only gives the desired degree of pressure, but also provides a medium for softening the gelatin so that the sheets are heated and pressed at one operation. Under these conditions, it is, of course, necessary that the pressure should be applied to the outer faces of the sheets to be joined, but not to the edges of the sheets where they come into contact, since fluid pressure applied at the lines of joinder between the sheets would penetrate the joints and tend to separate the sheets, so that the pressure on the faces of the sheets would be ineffective to secure the desired result. The means employed for preventing the application of fluid pressure to the juncture between the sheets will be readily seen by reference to the drawing. The claims include in combination an apparatus for use in securing together a set of sheets of similar size arranged in a pile with their edges flush to form a plate of composite glass, strips of sheet metal U-shape in cross section extending around the edges of the sheets and applying yielding pressure to clamp them together, and a strip of flexible sealing material of general U-shape in cross section fitting over the sheet metal strips with its edges free and in engagement with the outer faces of the outer sheets for a substantial distance inward past the inner edges of said sheet metal strips.



METHOD OF MAKING GAS-TIGHT SEALS BETWEEN GLASS AND METAL. U. S. 1,716,140. June 4, 1929. Christ Kirwer, East Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed 9/28/23. Heretofore, in order to produce an air-tight seal between a glass tube and a metal tube, the end portion of the metal tube has been formed into a knife-like edge and the glass tube has been welded to the inner surface of the knife-like end portion. The small thickness of the welded metal portion permits the metal to expand and contract in accordance with the expansion and contraction of the glass surface to which it is welded without breaking away therefrom. The inventor has found that by overlapping the end portion of the glass tube over the edge of the metal tube and welding it to both sides of the knife-like end portion, a glass-to-metal joint may be obtained which is superior, in its gas-tight properties, to any other joint known heretofore and at the same time it has a degree of ruggedness and mechanical strength which is lacking in all prior structures. The method consists in fitting a tubular glass member over the knife-like end portion, fusing said glass member to the outer surface of said knife-like end portion, a portion of said glass member projecting beyond the edge thereof, bending and folding said projecting portion over said edge, fusing the folded-over portion to the inner surface of said knife-like end portion, and then fusing the glass tube to the bend of said folded over tubular glass member.



MANUFACTURE OF WINDOW GLASS. U. S. 1,741,912. Dec. 31, 1929. Max Bicheroux, Aachen, Germany. Filed 1/30/29 and in Germany 1/27/28. In a device for making window glass from a mass of refined molten glass, in combination at least one pair of adjustable forming rolls adapted to roll the glass mass into a primary sheet of a thickness greater than the thickness of the finished product, means to support the glass sheet during its forward movement, a draft device for seizing the rolled sheet of glass at its forward end and drawing it to the desired final thickness, and revolving rollers arranged transversely of the sheet at such points where the sheet is still plastic, these rollers having oppositely handed helical threads extending from the middle to the ends of the rollers and designed to act on the sheet for smoothing it and stretching it in the direction of its width.



FROSTING GLASS ARTICLES. U. S. 1,740,376. Dec. 17, 1929. Rowland D. Smith, Corning, N. Y., assignor to Corning Glass Works, Corning, N. Y. Filed 5/19/28. A much less expensive and more efficient glass frosting solution than that used in prior methods can be obtained by fusing certain of the raw materials prior to their incorporation into the frosting solution.

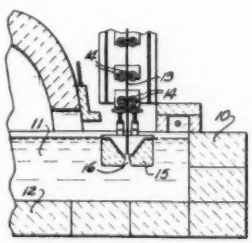
In the preferred form of the invention the batch for the frosting solution contains

	Pounds
Soda ash, Na_2CO_3	15
Ammonium carbonate, $(N.H_4)_2CO_3$	30
Sodium fluoride, NaF	11
Hydrofluoric acid, HF (60%)	135
Ammonium bifluoride, $NH_4F.HF$	168
Water	109

and this batch gives a resulting frosting solution consisting of

	Per cent
Hydrofluoric acid, HF (100%)	27.8
Ammonium fluoride, NH_4F	28.9
Water, H_2O	38.0
Sodium fluoride, NaF	5.3

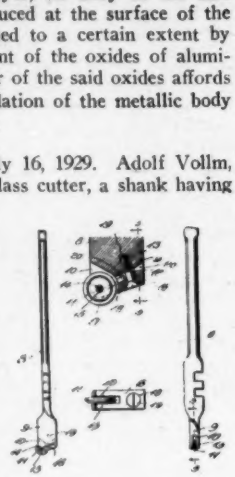
METHOD AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,739,936. Dec. 17, 1929. Horace E. Allen and Wilbur F. Brown, Toledo, O., assignors to Libbey-Owens Glass Company, Toledo, O. Filed 2/1/28. In the method of forming sheet glass, those steps which consist in creating two streams of molten glass by gravity flow, maintaining one surface of said streams free from contact, creating a stream by a hydrostatic head, uniting the streams and drawing a continuous sheet of glass therefrom, the uncontacted surfaces of the said gravity flowed streams constituting the surfaces of the formed sheet. One object of the invention is to provide means wherein the glass forming the outer surface of the drawn sheet is furnished by a surface flow of glass to the meniscus whereby the formed sheet will be free of the so-called "water silk" lines or other surface defects.



PROCESS OF FUSING METALLIC BODIES TO GLASS AND THE COMBINATION OF METALS USED IN SAID PROCESS. U. S. 1,724,465. Aug. 13, 1929. Rudolph Engels, Hamburg, Germany, assignor to C. H. F. Muller, Rontgen-Rohrenfabrik. Filed 2/25/26. The object of the improvements included in this invention is to provide a process by means of which oxidizable metals and glass may be fused without any difficulty and by mechanical means, and with

this object in view the invention consists in first coating the metallic body consisting for example of iron, copper, molybdenum, etc., or of alloys, at the part where it is to be fused to the glass, with a thin layer of a protective medium such, for example, as aluminium, having the function to produce, when heated to fusing temperature, a layer preventing the access of air to the metal. When using the aluminium as a protective layer, an alloy of the said aluminium and the fusing metal is produced at the surface of the said metal, and the said alloy is oxidized to a certain extent by the action of the heat. The melting point of the oxides of aluminium being above 2000° C., the thin layer of the said oxides affords a very effective medium preventing oxidation of the metallic body which is otherwise subject to oxidation.

GLASS CUTTER. U. S. 1,721,361. July 16, 1929. Adolf Vollm, Somerville, Mass. Filed 3/12/28. In a glass cutter, a shank having a lower edge at an acute angle to its front, edge, said shank being formed with a wheel-receiving groove which opens through both of said edges, a clamping block contacting with said lower edge of said shank and having a wheel-receiving slot registering with said groove, a cutter wheel in said groove and slot having a shaft disposed between said lower edge of the shank and said block, at least one of these members being recessed to receive said shaft, and a screw passing through said block and threaded into said shank for detachably securing the former to the latter.



PROCESS FOR PRODUCING CRACKLED GLASSWARE. U. S. 1,739,825. Dec. 17, 1929. Virgil O. Cornwell and Fred J. Blackburn, Columbus, O., assignors to the Federal Glass Company, Columbus, O. Filed 3/5/28. The method of producing crackled ware which comprises gathering glass upon a tool, marvering the gather, introducing air into the gather to form a hollow glass blank, and throwing streams of water against the hollow glass blank of a quality and quantity sufficient to produce crackles in the blank without changing the temperature of the blank to a degree that will prevent proper shaping thereof.

SHEET-GLASS-SURFACING APPARATUS. U. S. 1,739,925. Dec. 17, 1929. Erik G. Stahle, Pittsburgh, Pa., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 10/25/26. Means whereby a surfacing machine grinding or polishing type for glass may be easily and quickly moved out of operative position into a position where it is readily accessible whereby to facilitate the cleaning or repairing thereof; means for lowering and raising the surfacing machine in a vertical plane towards and away from the glass being surfaced, and means for preventing the lower end of the surfacing machine from swinging laterally with respect to the upper end thereof as the said machine is being raised and lowered.

GLASS-FORMING MACHINE. U. S. 1,733,473. Oct. 29, 1929. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company. Filed 8/30/26. Improvements in particularly the gravity fed or flow type of machine adapted to form milk bottles and other ware. An object of the invention is to eliminate the turnover of the parisons and minimize the degree of movement to which the parison is subjected and thereby entirely eliminate or at least minimize in the formation of the ware, the defects ordinarily caused by changing the position of the blank. Elimination of the turnover also permits compact arrangement of the molds so that the parison is exposed to the atmosphere for an unusually short period of time in its transfer from the blank mold to the finish mold, thereby maintaining the blank in proper position for the final blow.

DOWNFLOW SHEET-GLASS APPARATUS. U. S. 1,739,960. Dec. 17, 1929. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 12/19/24. An object is to provide means for flowing a stream of molten glass down both sides of a curved wall refractory slab in a manner that considerable support will be given thereto and the outer surface of one of the streams will be treated in a manner to form a relatively tough skin sufficiently strong to support the weight of the streams when united and drawn from the slab in sheet form.

GRINDING PATE GLASS. U. S. 1,740,005. Dec. 17, 1929. Joseph P. Crowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 4/10/24. In the art of grinding plate glass, the process of rough-grinding the sheet with a mixture of crystalline garnet and silica-sand, the sand serving as a cushion to control the abrasive action of the garnet, and then smoothing the sheet with fine silica-sand, grading the mixture by a settling process, whereby the coarser grades contain most of the garnet, the grinding and smoothing abrasives both being obtained from the same continuous grading process.

GLASS-SHAPING MACHINE. U. S. 1,740,310. Dec. 17, 1929. Edward H. Lorenz, West Hartford, Conn., assignor by mesne assignments to Hartford-Empire Company, Hartford, Conn. Filed 8/8/21. The machine is provided with a series of pairs of molds, each pair comprising a parison mold and a blow mold arranged side by side on a rotatable head, with their neck portions extending in opposite directions. The head is mounted to rotate on a horizontal axis extending radially of a rotatable carrier. The invention has incorporated certain safety devices in the machine by which it will be stopped in case of abnormal position or operation of its various parts.

FEEDING MOLTEN GLASS. U. S. 1,739,519. Dec. 17, 1929. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 10/31/25. An object of the invention is to employ a cup for receiving and shaping each mold charge prior to depositing it in the mold, and to prevent contact between the mold charge and the cup by providing, within the cup, a protective fluid film which supports the glass in the cup and prevents it from sticking to the cup in spots, as it would tend to do if the glass were allowed to come into direct contact with the walls of the cup.

MACHINE FOR FORMING GLASS ARTICLES. U. S. 1,739,845. Dec. 17, 1929. Richard La France, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Original application filed 4/22/24. Divided and this application filed 10/18/26. An important feature of the present invention consists in providing cooling nozzles for the molds, so arranged that they are automatically withdrawn to permit the discharge of the finished articles. There is also provided means for automatically cutting off the supply of cooling air while the nozzles are withdrawn, thereby effecting considerable economy in the amount of cooling air used.

METHOD OF PRODUCING HEAT-ABSORBING GLASSES AND BATCHES THEREFOR. U. S. 1,737,686. Dec. 3, 1929. Walter H. Rising, Painted Post, N. Y., assignor to Corning Glass Works, Corning, N. Y. Filed 5/24/29. The method of modifying the color of glasses resulting from the melting of a batch containing an element of the second periodic group, whose atomic weight is between 20 and 140, and substantial quantities of ferrous iron and a reducing agent by the addition to the batch of a small quantity of a substance containing tin.

GLASS-GRINDING APPARATUS. U. S. 1,742,594. Jan. 7, 1930. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company. Filed 10/29/23. In combination, a horizontal runner having a lower abrading surface and having a trough on its upper side extending from the inner portion of the runner outward with feed passages at different distances from the center of the runner extending downward from the trough to the lower face of the runner, and means for supplying a mixture of abrasive and water to the trough.

METHOD OF AND APPARATUS FOR CHARGING MOLTEN GLASS INTO MOLDS. U. S. 1,742,098. Dec. 31, 1929. Carl Henry Rankin, York, England, assignor to Rankin Automatic Glass Feeder Company, Limited, York, England. Filed 8/15/27 and in Great Britain 8/31/26. Apparatus for delivering a charge of molten glass to a mold, comprising a U-shape funnel whereof one part is movable rotationally in the other part.

METHOD OF AND MEANS FOR ROUNDING OFF OR BEVELING EDGES OF GLASS OR LIKE ARTICLES. U. S. 1,736,977. Nov. 26, 1929. Franz Liebl, Vienna, Austria. Filed 11/6/26 and in Austria 10/2/25. An improved machine by means of which it is possible to so treat non-circular, elliptic or oval edges of a work-piece

so that a chamfered or beveled edge of substantially uniform width and uniform inclination is formed.

GLASS-GROOVING MACHINE. U. S. 1,742,101. Dec. 31, 1929. Henry A. Schiedeman, Edgewater, Colo., assignor of one-half to The McMurtry Manufacturing Company, Denver, Colo. Filed 2/24/28. A device of the class described, comprising, in combination, a support, a frame, means for attaching the frame to the support so that it will move in a rectilinear path, means suspended from the underside of the frame work for supporting a glass plate and means for fastening the glass plate to the supporting means.

HEAT-ABSORBING BOROSILICATE GLASS AND METHOD OF MAKING THE SAME. U. S. 1,737,685. Dec. 3, 1929. Walter H. Rising, Painted Post, N. Y., assignor to Corning Glass Works, Corning, N. Y. Filed 5/24/29. The method of producing a heat-absorbing borosilicate glass which comprises melting under reducing conditions a batch containing silicon, boron, a metallic element of the second periodic group having an atomic weight between 60 and 120, and iron.

PROCESS OF TREATING GLASS FOR ILLUMINATION PURPOSES. U. S. 1,736,619. Nov. 19, 1929. Sherman G. Nye, Denver, Colo., assignor of part interest to Oscar D. Cass and E. E. Newman, Denver, Colo. Filed 2/14/28.

GLASS MOLD. U. S. 1,736,637. Nov. 19, 1929. Albert J. Throm, Jeannette, Pa. Filed 12/3/27.

APPARATUS FOR HANDLING GLASSWARE. U. S. 1,735,547. Oct. 29, 1929. Edward H. Lorenz, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 8/23/26.

APPARATUS FOR ANNEALING GLASSWARE. U. S. 1,736,322. Nov. 19, 1929. Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Original application filed 6/1/25. Divided and this application filed 10/12/25.

ADJUSTABLE CAM MECHANISM FOR GLASS-FEEDING APPARATUS U. S. 1,737,165. Nov. 26, 1929. Edward H. Lorenz, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 5/11/26.

FORMING HOT GLASS INTO MOLD CHARGES. U. S. 1,737,219. Nov. 26, 1929. Albert N. Cramer, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 8/6/20.

WIDTH MAINTAINER. U. S. 1,739,959. Dec. 17, 1929. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 12/1/24. Method and apparatus for maintaining the width of sheet glass while being drawn and making it possible to produce a wider sheet.

GLASS-POLISHING MACHINE. U. S. 1,740,247. Dec. 17, 1929. Edward J. Kiefer, New York, N. Y. Filed 5/1/25. For the polishing of glass tumblers and the like.

PROCESS AND SLOT MEMBER FOR MANUFACTURING GLASS SHEETS. U. S. 1,741,523. Dec. 31, 1929. Nicolai Powlowitsch Krasnikov, Moscow, Russia. Filed 8/8/28 and in Germany 2/1/27.

APPARATUS FOR BLOWING GLASS. U. S. 1,741,708. Dec. 31, 1929. John A. Milliken, Ambler, Pa., assignor to John E. Marsden, Philadelphia, Pa. Filed 11/13/22.

ART OF SHEET-GLASS MANUFACTURE. U. S. 1,741,886. Dec. 31, 1929. Laurence E. Stewart, Bradford, Pa., assignor to Rolland Glass Company, Clarksburg, W. Va. Filed 6/6/25.

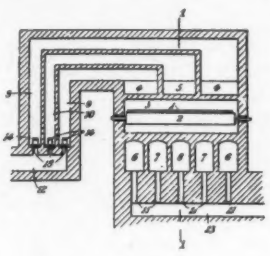
APPARATUS FOR SURFACING SHEET GLASS. U. S. 1,740,006. Dec. 17, 1929. Joseph F. Crowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 5/5/24.

GLASS-SHAPING MACHINE. U. S. 1,740,236. Dec. 17, 1929. Homer A. Genest, Hartford, Conn., assignor by mesne assignments to Hartford-Empire Company, Hartford, Conn. Filed 8/8/21.

APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,739,873. Dec. 17, 1929. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 10/31/25.

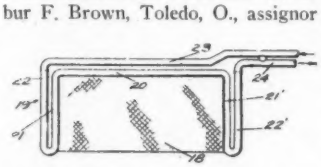
MANUFACTURE OF GLASS CYLINDERS. U. S. 1,736,005. Nov 19, 1929. Charles H. Harding, Fort Smith, Ark. Filed 6/21/27.

COOLING AND ANNEALING OF GLASS IN STRIP FORM AND APPARATUS THEREFOR. U. S. 1,744,478. Ernest Bristow Le Mare, St. Helenes, England, assignor to Pilkington Brothers, Limited, Liverpool, England. Filed 11/12/24 and in Great Britain 11/19/23. Process of cooling continuous glass strip in a lehr in which products of gaseous combustion are introduced into portions of the lehr both above and below the glass strip near the entrance end of the lehr, the amount of heat thereby supplied to the upper surfaces of the edge portions of the strip relatively to that supplied to their lower surfaces being controlled and the amount of heat supplied to the upper surface of the central portion of strip relatively to that supplied to its lower surface being independently controlled.



PROCESS AND APPARATUS FOR SEVERING GLASS SHEETS. U. S. 1,744,045. January 21, 1930. Howard L. Halbach, Clarksburg, W. Va., assignor to Pittsburgh Plate Glass Company. Filed 2/1/28. Apparatus for separating the edge of an upwardly moving sheet of glass, which comprises a clamping member extending transversely of the sheet and free to move with the sheet, a heating element extending longitudinally of the clamping member, a second heating element extending longitudinally of the sheet adjacent the edge thereof and supported at its lower end upon said clamping member, means for intermittently clamping said member against the glass so that it moves along with the glass, spring means holding the upper end of the second heating element in advance of its lower end and in advance of the first mentioned heating element, and means for causing a flow of electric current through both of said elements to heat them.

GLASS-MELTING FURNACE. U. S. 1,744,359. Jan. 21, 1930. Wilbur F. Brown, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, Ohio. Filed 2/28/27. The combination with a glass melting furnace adapted to contain molten glass and including a melting tank having a reduced neck portion at one end thereof, of means arranged within said neck portion and disposed within the molten glass for straining the same as it flows therethrough.



METHOD AND APPARATUS FOR PRODUCING PLATE GLASS. U. S. 1,744,372. Jan. 21, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 1/14/27. In apparatus for producing plate glass, a plurality of movable tables, means for forming a series of glass blanks thereon, an annealing leer, means for carrying the tables in one direction through said leer to anneal said blanks and cool said tables, means for carrying said tables in the opposite direction back through said leer whereby to heat the same prior to the forming of another series of blanks thereon, and means for grinding and polishing one surface of the glass blanks after the cooling but prior to the heating of said tables and without removing the said blanks therefrom.

PROCESS AND APPARATUS FOR ANNEALING GLASS. U. S. 1,744,377. Jan. 21, 1930. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 1/2/26. In a leer for annealing and cooling a continuous glass sheet, roller means for moving the sheet therethrough, means for releasing supplemental heat into the atmosphere along a portion of the leer, sealing means for preventing draft currents of local character at the level of sheet, and means for causing local escape movement of heated atmosphere at different levels below the sheet.

Colored Glass Makes Possible Light Symphonies for Interior Decoration

The possibility that the interiors of homes, public buildings and theatres may soon be completely redecorated every day by merely touching a button was demonstrated for the first time before 2,000 illuminating engineers, scientists and representatives of the electrical industry at the recent opening of the new ballroom containing 9,500 square feet of floor space in the Hotel St. George in Brooklyn. The demonstration took place in connection with a meeting of the Illuminating Engineering Society.

Christened Colorama, the application of the third dimension in color lighting to homes and public buildings makes possible thousands of color combinations and patterns upon walls painted plain white and devoid of all ornamentation. These colors and patterns remain stationary or continuously merge by means of a remote control board. This board is, in effect, a mechanical console upon which the color organist plays a symphony of light, controlling more than 7,000 lamps of red, blue, green and clear glass concealed in a series of coves and flutes in the walls and ceilings.

Though only red, green and blue are used, the mixing of these gives hundreds of shades of gray, orange, black and white, yellow, purple and cerise, as well as many pastel shades. The shade of color produced, the audience was told, depends upon the wattage employed for each primary color and also upon the location of the lamp, whether it is in front of the flute or behind it. The design effects produced depend in turn on the relative position of the coves and flutes to one another.

According to F. J. Cadenas, Lighting Engineer of The National Lamp Works of General Electric Company, one of the developers of the new method of lighting, the success of this new system depends on the effects produced by the variations in the amount of the different colors and on the exclusion of all natural light. The color effects which can be obtained are unlimited in number. So far more than 1,200 combinations and color effects have been produced. It is possible to automatically produce a new color scheme on all four walls and ceiling of a room every fifteen seconds. Running continuously this means that the color and patterns in a single room can be changed every fifteen seconds for approximately two and one-half hours.

The first installation of Colorama used in the demonstration a total of 532,246 watts, or more light than the entire city of New York possessed in the early days of incandescent lighting. The installation took sixty electricians nine weeks to install and cost $150,000. It is pointed out, however, that this cost is low when redecoration is considered.

The coloring and patterns need not necessarily be confined to conventionalized patterns.

Though, for the present, the presence of outside light robs Colorama of much of its charm, General Electric engineers expect it to be used in the near future to brighten up gloomy rooms in apartments, offices and homes.

A Matter of Dollars and Cents[1]

By J. C. DAVIE[2]

During the last few years considerable stress has been laid upon the economics to be effected by heavier loading. Due, no doubt, to the fact that the campaign for heavier loading emanated from the carriers' "side of the fence," the campaign has been carried on with the savings to the carriers foremost in mind.

That maximum utilization of rolling equipment will help to eliminate car shortages and congestions thereby directly benefiting shippers, is true. But there is another factor which has been overlooked, namely: the actual cash saving resulting from the purchase of raw material in full carload lots instead of quantities approximately carload minima.

In the illuminating glassware industry, practically all raw materials are purchased in carloads, and the purchasing agents of the member companies are being constantly reminded, through the Transportation Committee of the Illuminating Glassware Guild, of the economies to be effected by ordering full carloads instead of a specified number of barrels or tons, which latter method is a heritage of the past.

We have found that 2 carloads each containing 60 tons can be unloaded at a lower cost per ton than 3 carloads containing 40 tons each. When cars are unloaded at a fixed price per car, we have found that a gang is willing to handle the car for the same amount whether it contains 40, 50 or 60 tons. Even if certain industries do not have their unloading performed on a contract basis, there is a considerable time saving in the operations of opening doors, placing plates, switching, removing and replacing mechanical unloaders, etc., during which operations men stand idle when they could be engaged in productive labor.

[1]From *The Atlantic*, official publication of the Atlantic States Shippers' Advisory Board.

[2]Gill Glass and Fixture Company, Philadelphia. Chairman, transportation committee Illuminating Glassware Guild.

New Publications

"DER INDUSTRIELLE WÄRMEÜBERGANG" (Industrial Heat Transfer) by Dr. A. Schack, published by Stahleisen, Dusseldorf, Germany, 1929. 408 pages 5½ by 8", 41 illustrations, price 18.50 marks. A review of this book by Prof. W. Trinks of the Carnegie Institute of Technology follows:

Here is a book that contains in a lucid and well-arranged manner the various heat transfer formulae that heretofore were scattered through the literature of many countries. The book also contains the derivation of the various formulae and some heretofore unpublished material. Furthermore, it contains critical discussions with regard to the range of applicability of the different formulae.

Dr. Schack is well known for the classical work done by him in radiation of gases and flames.

The book treats of conduction, convection, and radiation. It considers constant and variable heat flow, simple and composite walls, parallel flow, cross-flow, and counterflow, heat transfer from condensing vapors; recuperators and regenerators, luminous and non-luminous flames, heat transfer in boilers, radiation through openings. Last, not least, Dr. Schack's book contains almost 20 pages of well selected physical constants such as thermal conductivity, density, specific heat, viscosity, and radiation coefficients.

All formulas are derived from first principles, and the reliability of experimental coefficients is critically discussed at the hand of all available data. The author has done fairly well in utilizing international data, although German experimenters, quite naturally, predominate.

An early translation of Dr. Schack's work is very desirable, because there is no book in the English language now available that offers engineers just what they need in heat transfer. The book should find a ready market among mechanical engineers (including automotive and refrigerating engineers), chemical engineers, and metallurgists. Heating and ventilating engineers will, likewise, find many valuable hints in Dr. Schack's book, particularly in the study of the relations between heat transfer and pressure drop in pipes.

X-RAY STUDY OF FIREBRICK, by Albert E. R. Westman, research associate in ceramic engineering, Engineer Experiment Station, Urbana, Ill. Published by the University of Illinois, Urbana, Ill. Price 15 cents.

When a thin section or a powdered sample of a commercial firebrick is examined under a petrographic microscope, a considerabe portion of the material is found to be so finely divided or so deeply colored that its mineralogic composition cannot be determined. This is particularly true of soft-fired bricks or bricks containing relatively large percentages of iron or titanium. Even with the best microscopic equipment, it is difficult to make positive identification of crystals in a firebrick whose diameters are smaller than about 100,000 Angstrom units. With X-rays, on the other hand, it is possible to obtain diffraction patterns from particles with diameters as small as about 50 Angstrom units, or about one two-thousandth the diameter of the smallest particles suitable for petrographic work. It was the purpose of the investigation reported in this bulletin to obtain powder diffraction patterns of a number of brands of commercial firebricks, to find what information could be obtained from the patterns, and to compare the information, so obtained, with that secured by thermal expansion measurements, petrographic examinations, and chemical analyses. X-ray powder diffraction measurements of 14 brands of firebrick are described and the data obtained, reported and analyzed. A comparison of data obtained from thermal expansion, petrographic, and chemical studies has been made.

First Complete Glass Plant Built Exclusively for Experimental and Development Purposes

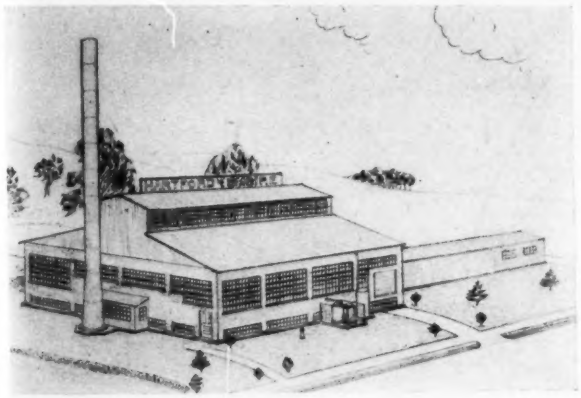
(Communicated)

Hartford-Empire Company has again shown its usual foresight in placing a large contract with the Simplex Engineering Company for the construction of a modern, up-to-the-minute glass plant on their property at Hartford.

This plant will not be operated as a manufacturing plant, but will be devoted entirely to experimental and development purposes.

As far as we can learn, this is the first complete plant of its kind that has ever been built in America. The plant will be equipped with all modern facilities which will permit the Hartford company to carry on an extensive development program.

This announcement should be of great interest to all users of Hartford equipment. New inventions, new processes, and new



HARTFORD-EMPIRE EXPERIMENTAL PLANT

types of machines will be developed under the guidance of the engineering and scientific staffs of the Hartford company.

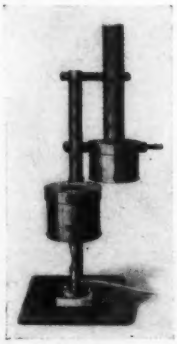
There is no doubt that the results of an undertaking of this kind on such a large scale will prove of inestimable value to that portion of the glass industry that is affiliated with the Hartford company in the use of Hartford equipment.

New methods and new equipment seldom result from chance invention. No new development is undertaken by the Hartford company until scientific research and technical investigation leads to the conclusion that the projects will have practical application and commercial value.

Most manufacturers can hardly afford to carry on extensive and costly development work. Their business is to produce glassware. The business of the Hartford-Empire Company is to produce machines and processes for the manufacturer. A very large part of the Hartford company's income is annually expended in not only giving mechanical, technical and scientific service to its licensees, but in protecting and developing new and improved equipment for their use.

New Laboratory Furnace

A new gas fired laboratory furnace fitted with an atmospheric burner which requires no auxiliary equipment and can safely be left to burn unattended, has been placed on the market by The Babcock & Wilcox Co., 85 Liberty Street, New York. It is said that this furnace will maintain a uniform temperature over a long period and if fitted with the usual gas pressure regulator will maintain a temperature of plus or minus ten degrees F. for several days. Tests made at the Massachusetts Institute of Technology show the furnace to be capable of being brought from room temperature to 2500°F. in about 30 minutes and to 2000°F. in approximately 15 minutes. The maximum temperature is over 2600°F. using ordinary manufactured illuminating gas under the usual 3" (water gauge) pressure. The maker states that these unusual time-temperature operating characteristics are due to the use of proper gas velocities in the furnace, the stack proportions, a unique baffling arrangement, and the use of the new B. & W. No. 80 refractory insulator lining having an extremely low heat conductivity. Natural or manufactured gas may be used, the former producing slightly lower temperature than the latter. Special attention is called to the utility of the furnace for calibrating thermocouples from the freezing points of metals, melting the samples of glass, glazes, enamels, as well as burning small bodies of ceramic materials.



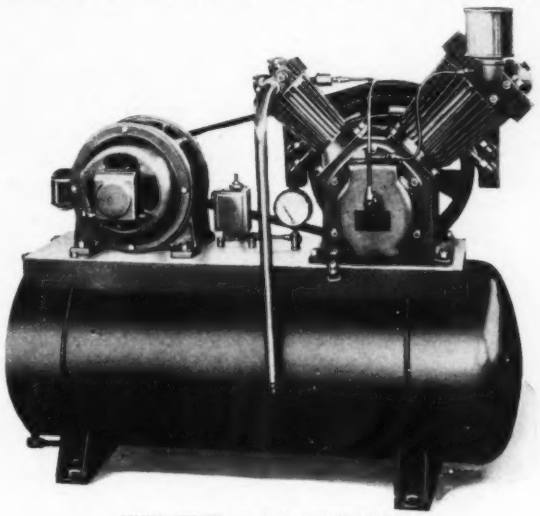
New Line of Air Compressors

A new line of air-cooled, two-stage air compressors, known as the Type 30, has been brought out by Ingersoll-Rand Company, New York. V-type belt drive is employed. Both motor and compressor have ball bearing.

The units are self-contained, the motor and compressor being mounted on a steel base which is attached to the top of the air receiver. The latter, which is made of heavy pressed steel, is built to withstand a working pressure of 200 pounds. With this arrangement, no special foundation is required for correct alignment of the compressor and motor. The compressor is ready to operate as soon as the electrical connections to the motor have been made and the crankcase filled with oil.

The intercooler is located behind the fan-type flywheel, and a constant current of circulating air is driven directly across the cooling coils. This reduces the temperature of the discharge air.

Automatic start and stop control, furnished as standard equip-



NEW TYPE 30 T-R COMPRESSOR

ment, operates independently, but in conjunction with the unloader. When the pressure in the air receiver reaches a point at which the regulator is set to unload, the motor is automatically shut off. A centrifugal governor allows the air in the high-pressure cylinder and intercooler to exhaust through the crankcase. This prevents the compressor from starting against a load.

Honed cylinders and two oil control rings reduce the oil in discharge air to a minimum. Each piston is run into its respective cylinder, insuring a perfect oil seal.

The base of the compressor unit forms a reservoir for the oil, and no oil pump is required. A bayonet gauge gives positive indication of the amount of oil in the reservoir.

It has a self-cleaning air cleaner, and is entirely enclosed. The purpose of this improved two-stage design is to reduce power from 10 to 30 per cent, and at the same time, lessen the floor space required. It is built in four sizes: ¾, 1½, 3, and 5 horsepower. All sizes are built for a working pressure up to 200 pounds continuous duty. Bulletin 3060 describing the compressor can be obtained by addressing the Ingersoll-Rand Company, 11 Broadway, New York.

Libbey-Owens Earnings Last Quarter, 1929

Libbey-Owens Glass Company reports a net profit of $582,746 for the three months ending December 31, 1929, after providing for an estimated Federal income tax of $80,000.

National Building Forecast Indicates Good Year

For the past eight years the *Architectural Forum*, a leading professional journal now controlled by the National Trade Journals, Inc., has presented an exhaustive study of the work under way in the architectural offices of the country for the ensuing year. This building forecast has been based on individual confidential reports received from architects all over the country and has made possible a picture of future building activity which cannot be obtained in any other manner.

The matter following is abstracted from the national forecast for 1930 which was released January 15.

To a great extent the architects, engineers and contractors of this country represent the advance guard of its building construction. They constitute the first group which records changing trends in the volume and type of building construction. They know long in advance what is going to happen.

The building industry, including its advance guard of architects, engineers and contractors, is looking forward to the year 1930 with rapidly growing optimism.

The three primary factors which will influence the building program of 1930 include the volume of projects which are contemplated; the availability of mortgage money and public financing for such projects; and the so-called Hoover program. The steps taken to prepare this forecast, therefore, have included first, the obtaining of individual reports from architects, engineers and contractors to gain some measure of the projects under planning or discussion for 1930 and second, the obtaining of a cross-section of opinions from the leading mortgage companies as to the probable availability of money to finance the construction program of 1930.

A telegraphic survey conducted at the end of December by the Research Department of National Trade Journals, Inc., among officials of leading savings banks, building loan associations, title companies, insurance companies, and other mortgage lending institutions in every part of the country, elicited the information:

That there have already been signs of easier mortgage money since the Wall Street collapse.

That it will take the early part of 1930 for adjustments to clear away the obstacles already described as blocking the mortgage money channels.

That we may with some confidence expect much easier mortgage money conditions in the second half of 1930.

That there are a large number of building projects which will seek financing during 1930.

It is apparent that for a period representing probably the first half of 1930 mortgage money channels are seriously blocked by two obstacles. In the first place, savings banks and possibly even building and loan associations, were drained heavily for funds to meet stock margin and collateral loan requirements. The funds which might ordinarily go for mortgage purposes have been used to meet demands of the Wall Street collapse. Thus this important channel of mortgage money is temporarily dammed and will reestablish itself only as savings and conservative investments mount again. But they will surely mount because the public has learned a lesson. The second obstacle is the fact that many mortgages coming due at this time are being called by mortgagees who wish to use the money to cover their own situations. These mortgages on existing buildings must be replaced and as a rule they take precedence over loans for new construction. These must be cleared out of the way and this readjustment has already begun.

There have been tremendous developments in the manufacturing side of the building industry. Not only have great capitalists become actively interested but the very size of the industry has forced added vision, and together with an intricate combination of research and technical improvements, which is completely changing many of our construction methods, materials and equipment, some of the great basic divisions of the building industry, such as steel and lumber, are being forced to the development of hundreds of specialties for the building industry. There has been a tremendous increase in the application of engineering skill to the solution of building problems. All of these, while they require far greater study and more comprehensive understanding on the part of the architect, contribute in turn to the quality of the finished buildings.

BUILDING TYPES	N. EASTERN STATES	N. ATLANTIC STATES	S. EASTERN STATES	S. WESTERN STATES	MIDDLE STATES	WESTERN STATES	U. S. A.
Automotive	$23,361,800	$47,580,500	$6,519,000	$18,978,900	$56,575,900	$16,859,200	$169,875,300
Banks	37,806,100	31,602,800	2,029,500	10,688,700	48,515,300	7,281,600	137,924,000
Apartments	27,765,200	325,954,100	9,114,300	26,026,800	95,407,000	68,355,200	552,622,600
Apartment Hotels	2,980,700	65,050,600	8,466,500	24,571,300	73,156,300	36,367,000	210,592,400
Clubs, Fraternal, etc.	5,797,400	44,653,100	2,242,700	17,978,500	75,891,000	15,243,800	161,806,500
Community and Memorial	6,437,000	26,486,000	861,000	5,608,800	26,670,500	26,752,500	92,815,800
Churches	12,685,400	44,665,400	30,262,100	34,784,400	70,876,700	23,993,200	217,267,200
Dwellings (Below $20,000)	24,751,700	33,968,500	10,245,900	11,676,800	41,323,900	15,846,500	137,813,300
Dwellings ($20,000 to $50,000)	11,877,700	44,362,000	8,269,700	9,983,500	45,628,900	15,571,800	135,693,600
Dwellings (Over $50,000)	13,300,400	39,524,000	6,642,000	6,810,100	34,739,300	11,041,300	112,057,100
Hotels	13,919,500	78,941,400	31,910,300	76,711,000	87,649,800	104,468,000	393,600,000
Hospitals	33,488,800	161,523,600	11,500,500	46,649,800	94,025,300	24,190,000	371,378,000
Industrial	14,358,200	58,634,100	23,985,000	21,381,500	141,060,500	29,725,000	289,144,300
Office Buildings	56,662,000	250,788,800	1,107,000	41,922,500	255,930,200	72,426,500	678,837,000
Public Buildings	14,296,700	88,182,800	7,293,900	18,876,400	146,062,500	44,062,700	318,775,000
Schools	47,855,200	188,395,000	30,053,000	77,174,300	223,003,100	74,374,000	640,854,600
Stores	15,485,700	74,136,200	8,790,400	10,282,800	43,726,500	14,509,900	166,931,500
Theatres (All Types)	11,808,000	21,250,300	10,036,800	15,260,200	30,167,800	9,056,900	97,580,000
Welfare Y.M.C.A. etc.	29,151,000	59,749,300	5,817,900	8,581,300	34,517,900	5,510,400	143,327,800
TOTAL VALUE OF NEW BUILDINGS	$403,788,500	$1,685,448,500	$215,147,500	$483,947,600	$1,624,928,400	$615,635,500	$5,028,896,000

New Construction Under Architect's Supervision	$5,028,896,000
Buildings of All Types—Excluding Public Works and Utilities—Not Designed by Architects (Estimated from Averages of Previous Years)	1,972,000,000
TOTAL ESTIMATED CONSTRUCTION FOR 1930 (Exclusive of Public Works and Utilities)	$7,000,896,000

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SUMMARY OF NATIONAL BUILDING FORECAST FOR 1930

The year 1929 would have represented a very large volume of construction business if its foundation of mortgage money had not been almost entirely removed. The building industry cannot compete with high priced call money. It cannot show the dramatic profits which the ticker tape has spelled out through this past period of blind speculation, but the building industry can and will compete with any line of legitimate investment or even speculative profit and it looks very much as though it is about to have its chance again.

The sudden interest of President Hoover in stimulating construction activity as a means toward economic stabilization, together with the promising aspect of financing for building projects has led to an unusually optimistic outlook. The Hoover program is well known to all because of the wide publicity given to it by newspapers within the past few weeks. President Hoover has nominated the construction industry as the most forceful potential factor toward the stabilization of prosperous conditions. He has set an example by stimulating government, state, city and public utility construction. He has focused the interest of everyone on the desirability to immediately start programs of construction, including public buildings, roads, harbor projects and similar contemplated improvements. That this activity has already provided a stimulus for construction activity is obvious.

In every direction it seems that forces are gathering which may show the year 1930 as an unusually active year for the construction industry and perhaps as the beginning of an interesting cycle of active years as the public turns again to mortgage financing as an outlet for its money and to buildings as important factors in maintaining the proper operation of commercial and community existence.

Increase in Industrial and Commercial Construction

F. W. DODGE CORPORATION REPORTS

Construction contracts recorded during the year 1929 in the 37 Eastern States reached a total of $5,754,290,500, according to F. W. Dodge Corporation. Compared with the total for the record year 1928, this was a decrease of 13 per cent. Commercial and industrial building reached a combined total of $1,689,200,800 last year, an increase of 11 per cent over 1928; these classes of work usually increase when general business activity and the stock-market are on the upswing; public and institutional buildings of all kinds (constituting the remainder of the non-residential classes) amounted to $901,020,200 last year, representing an 8 per cent decrease from 1928. Non-residential building as a whole had contract expenditures just 3½ per cent above those of 1928.

The decline was most severe in residential building, whose 1929 total was $1,915,727,500, being 31 per cent under the 1928 total. Even public works and utilities, contracts for which kept somewhat ahead of 1928 very nearly to the end of the year, finished with a contract total of 7 per cent under that of 1928, or $1,248,342,000 as compared with $1,337,930,500.

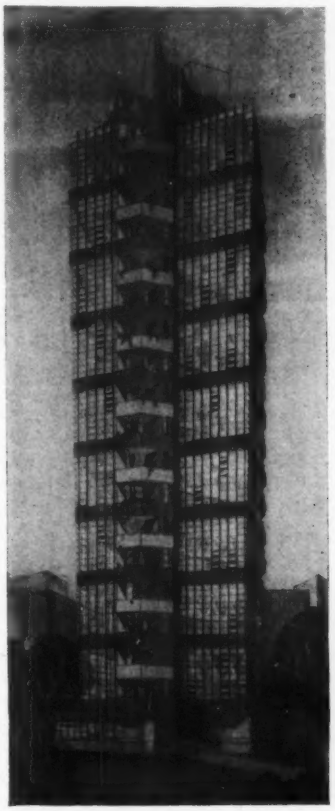
Although the financial upheaval which reached its climax in late October was in the nature of a removal of serious obstacles to construction improvement, it came too late to aid any improvement in the 1929 construction record. December contracts amounted to only $316,368,100 which was 19 per cent under November, 1929. The month's record included: $114,049,800, or 36 per cent of all construction, for residential buildings; $67,392,400, or 21 per cent, for industrial projects; $51,821,300 or 16 per cent, for public works and utilities; $33,392,100, or 11 per cent, for commercial buildings; and $19,841,800, or 6 per cent, for educational buildings.

A much more promising showing was made in the December record of contemplated projects. New plans reported during the month amounted to $864,220,600, an increase of 19 per cent over the amount reported in December, 1928, and a 20 per cent increase over November, 1929. The total of contemplated new work reported in the entire year was $8,886,017,500. This was 54 per cent in excess of the amount of contracts, a very good indication that the year closes with a considerable volume of unsatisfied construction demand.

Planning an Industrial Safety Campaign. Safe Practices Pamphlet No. 51, National Safety Council, Chicago, summarizes safety campaign methods in use by a number of industrial organizations. Copy sent on request.

Architect Designs Glass and Concrete Building

Presented herewith is a reproduction of an architect's design for a building of revolutionary character composed practically altogether of concrete, copper and glass. Much interest was shown last October when Frank Lloyd Wright, a well known Chicago architect, announced at a meeting in New York of the American Union of Decorative Artists and Craftsmen that he intended to erect an apartment house in the vicinity of St. Mark's-in-the-Bouwerie at Eleventh Street and Second Avenue, New York. The design produced by Mr. Wright is not only unique as regards the materials of construction which he proposed to use but



PROPOSED CONCRETE AND GLASS STRUCTURE

also is novel in other respects. As Mr. Wright describes the building and as shown in the drawing the structure will rise eighteen stories with a two story pent-house at the top. The entire building is to be supported on a central core, the whole resting on a concrete base set in bedrock. From the central core of the building shelves or floors will extend and over these shelves the glass and copper shell will be constructed, the walls consisting entirely of heavy plate glass and the necessary copper fittings to hold it in place. No structural steel will be employed. Each of the four projected buildings will contain 36 duplex apartments scientifically arranged to be equivalent to an average five room apartment. They will cost about $400,000 each.

Mr. Wright contends that these glass buildings will be beautiful "because beauty is something that is structurally true," and that they will not only afford their tenants light and sunshine but will let sunshine, light and air into the streets. The question as to whether they can be properly heated remains to be answered.

A novel feature of the design is that at regular intervals the upper stories in pairs extend out over the lower stories, the extensions being supported on abutments. In describing his design Mr. Wright stated that the upper stories of the building are more valuable for business or residential purposes than the lower stories. By this arrangement of offsets at different points the area of the upper floors is increased and other advantages accrue. Because of the projecting sections the building as a whole will have somewhat the appearance of an inverted pyramid.

The Glass World and What It Is Doing

News of the Industry

W. E. Levis in Full Charge of Owens-Illinois

For a young man to have brought himself at the age of 39 to a position at the head of the greatest manufacturing company in its line in the world, is a most unusual achievement.

William Edward Levis, president and general manager of Owens-Illinois Glass Company, Toledo, Ohio, was born December 14, 1890, at Alton, Ill., a son of Charles Levis, now retired, who was Vice-President of the Illinois Glass Company, and one of its founders, and of Harriet (Parker) Levis, both of American ancestry for several generations back.

William E. Levis received his education at Culver Military Academy, Culver, Ind., supplemented by a course at the University of Illinois, graduating therefrom in 1913 with the degree of LL.B.

Shortly after his collegiate career he went to work for the Illinois Glass Company at Alton, Ill., starting in at the bottom to learn the business thoroughly and went through the various departments, mastering all the details and became assistant secretary and treasurer of the company, later vice-president and general manager and finally president of the company. Upon the merger of his company in 1929 with the Owens Company of Toledo, the name was changed to Owens-Illinois Glass Company, and Mr. Levis became 1st vice-president and general manager, which position he held until January 15, 1930, when he was elected president, and devotes the major portion of his time and attention to his duties at the executive headquarters of the company in Toledo, Ohio. He is president of the Illinois Glass Consolidated Corporation, Alton, Ill., which corporation owns the Illinois Glass Company, of which company he is also president. This corporation also owns the controlling stock of The Western Company, manufacturers of the Dr. West tooth brush and tooth paste products. They also have controlling stock of the Kimble Glass Company of Vineland, N. J., who are the largest manufacturers in the world of chemical glassware. The corporation also owns the controlling stock of the Illinois Carton & Label Company of Chicago, and the Chicago Cork Works. In the latter three companies Mr. Levis is vice-president and a director; also a director of the Illinois-Pacific Glass Corporation of San Francisco, Illinois Terminal Railroad System of Chicago and of the Alton & Eastern Railroad Company of St. Louis.

He is a member of the University Club of Chicago, University Club of St. Louis University, The Country Club, University Club and Toledo Club, all of Toledo, Ohio, and of the Sigma Chi Fraternity.

During the World War Mr. Levis was sent to the Officers Training Camp at Camp Ft. Sheridan, from whence he was sent to France serving with the British Army, as 2nd Lieut., with the American Expeditionary Forces 30th Infantry, 3rd Division, Regimental headquarters, France. He received the Distinguished Service Cross for Extraordinary Heroism July 15, 1918.

Mr. Levis was married June 29, 1915, to Miss Margaret Harris of Champaign, Ill. In politics he is Republican. His principal recreations are horseback riding and hunting.

New Bottle Factory for Venezuela

J. Corao, president of the Compania Anonima Manufacturera De Vidrio Y Cristal, Caracas, Venezuela, S. A., arrived in New York in the latter part of January for the purpose of buying equipment and supplies for a modern bottle factory which the company will erect on the site of its present plant which is to be torn down. The new factory will have a capacity of 60,000 bottles a day. It is now operating the O'Neill machine and the intention is to increase the number to six. Mr. Corao is visiting several of the important glass manufacturing centers and investigating various types of equipment including furnaces, lehrs, fuel oil burners, etc. Heretofore his company has bought their soda ash and some other supplies in England but they are now interested in quotations on American chemicals including soda ash, potash, borax, aluminum hydrate, burnt lime, selenium, cobalt oxide, etc. The company is capitalized at 4,500,000 bolivares equal to approximately $900,000 in United States money.

Glass Division Program Completed

The tentative program for the Toronto meeting of the Glass Division of the American Ceramic Society was given in the January number. The final program has been received just as the February issue goes to press, too late for complete reproduction.

It shows a few additions to the list of papers to be presented at the Glass Division meetings as follows:

"Some Results Obtained Through the Use of Borax in the Manufacture of Tank Glasses," by D. D. Schurtz, The Sharp Schurtz Company. "Crystallization Relations in Soda-Lime-Silica Glasses," by G. W. Morey, Geophysical Labratory. "Discussion on Close Control of Color and Translucency in Lenses," by A. G. Johnson, Western Electric Company. The titles of one or two of the papers have been changed. The program now stands as follows:

February 18, Tuesday morning meeting. "Electrical Glass Melting," by James T. Burt-Gerrans. "Colored Glass for Technical and Decorative Purposes," by H. P. Gage. "Electrical Methods for Determining Moisture," by E. F. Burton. "The Use of the Polariscope in the Glass Industry," by Frank W. Preston. "Corrosion of Tank Blocks by Opal Glass," by C. J. Uhrmann and S. M. Slater.

Tuesday afternoon meeting: "Discussion on Opacifiers for Glass, led by A. Silverman. "Discussion on Close Control of Color and Translucency in Lenses," by A. G. Johnson. "Production of Glassmakers' Feldspar, by Rudolph Glatly. "Beryllium Glass II, Potassium Beryllium Silicate," by Prof. A. Silverman and Chi Fang Lai. "The Influence of Chemical Composition on Refractive Index, Softening Point, and Density of Soda Lime Glasses," by J. W. Gill and W. C. Rueckel.

Wednesday morning meeting: "The Effects of Additions of CaO and MgO Upon Some Physical Properties of Glass," by C. W. Parmelee and D. T. H. Shaw. "The Effects of Additions of Zinc Oxide and Cadmium Oxide on Simple Glasses," by C. W. Parmelee and R. G. Ehman. "Some Results Obtained Through the Use of Borax in the Manufacture of Tank Glasses," by D. D. Schurtz. "The Electro Chemical Behavior of Glass," by John Bright Ferguson. "Progress Report on Bureau of Standards Investigation of the Effect of Dissolved Gases in Glass," by R. C. Darnell. "Modified Method for Decomposing Aluminous Silicates for Chemical Analysis," by A. N. Finn and J. F. Kleekotka. "Dimensional Changes Caused in a Pyrex Glass by Heat Treatment," by A. Q. Tool, E. L. Peffer and J. B. Saunders. "Crystallization Relations in Soda-Lime-Silica Glasses," by G. W. Morey. "Notes on the Chemical Analysis of Glass," by G. E. F. Lundell. "Actions of Dust from the Batch on the Checker Brick of Glass Furnace Regenerators," by D. S. Beliankin and M. A. Besborodov. "On Expansion-Measurements of Several Glasses by Means of Self-Registering Apparatus," by Willi M. Cohn.

Plate Glass Production in 1929

As has been evident during the course of the past year, the production of polished plate glass in the United States by the end of the year far exceeded any previous record. The total quantity produced was 150,498,287 square feet. Had not the production fallen off heavily during the latter part of the year a still more remarkable record would have been achieved. December production was but 8,482,289 square feet compared with the November figure of 12,130,845 square feet. The production figures as compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America show the quarterly production to have been as follows:

First quarter	35,859,187	square feet
Second quarter	37,614,956	" "
Third quarter	41,790,106	" "
Fourth quarter	35,234,038	" "

Trade Activities

W. L. Monro, president of the American Window Glass Company, has been elected president of the American Tariff League.

Edgar B. Brossard has been appointed chairman of the United States Tariff Commission for the year beginning January 15, 1930.

The Flat Glass Manufacturers Bureau, Inc., has obtained a Delaware charter to deal in glass and glassware, through H. E. Grantland, Wilmington, Delaware.

The Pittsburgh Plate Glass Company recently acquired the business of W. J. Schconover Glass Company whose headquarters were in Scranton, Pa. It is reported that the sale involved about $500,000.

The Fulton Glass Company, Inc., Hartford City, Ind., early in January elected the following officers: President, George T. Fulton; vice-president, George L. Fulton; secretary, James P. A. Fulton; treasurer, George T. Fulton.

Edwin M. Allen, president of the Mathieson Alkali Works was appointed at the economic conference sponsored by President Hoover in Washington in December to represent the chemical industry on a general economic executive committee of 72 "key" men who will assist in organizing a permanent body whose purpose is to work along lines intended to prevent business depressions.

Wm. J. Miller, Inc., Swissvale, Pa., recently announced the shipment of two additional latest model YBA paste mold machines to the Dunbar Flint Glass Company, Dunbar, W. Va. They will be used for the production of high grade paste mold tumblers, chimneys, etc. A model AAK toggle type tableware press has been shipped to the Diamond Glass-Ware Company, Indiana, Pa., and model DAC semi-automatic combination press and blow machine has been shipped to S. Picone Glass Works, Naples, Italy, where it will be used for making tumblers, opal ware, pressed and blown lamp chimneys.

The Pacific Coast Glass Company, San Francisco, announce through Ray H. Williams, manager of the Los Angeles warehouse, that the West Coast Glass Company of Los Angeles has been purchased by his organization. This factory will be devoted to manufacturing products for distribution in the Southern territory, including bottles, jars, containers, etc. It is being modernized and it is said that operation will begin within a couple of months. Included in the improvements is the construction of a warehouse containing approximately 30,000 square feet of floor space. This will replace the warehouse in which the Pacific Coast company at present carries its stock. It is reported that the purchaser of the West Coast plant will have an investment of approximately $350,000 in the business.

New Edition of Diamond Alkali Handbook

A seventy-two page, 6 by 9 inch publication containing a large amount of information relating to the Diamond Alkali Company and its products has just appeared. The first edition was published in 1924. Mention is made of the facilities of the Diamond Alkali Company which include a technical department with a staff of trained technicians, prepared to render either consulting or personal service to the users of Diamond products. A traffic department is maintained, the Diamond plant being directly served by three trunk lines. A brief description of the process by which the Diamond brand of soda ash is manufactured is given. Manufacturing operations are conducted near Painesville, Ohio, not far from Lake Erie, which it is pointed out is close to sources of raw materials which consist principally of salt, limestone, ammonia, coal and water.

The ammonia-soda process which is employed is briefly described. The chemical reactions obtained in the process are given. A table is given for use in converting from one to the other of the systems used to express the alkalinity of soda ash and caustic soda. Other tables are given including one showing the gross and net shipping weights and storage space required for materials shipped in bags, barrels, kegs and drums. The Company's products include in addition to soda ash, caustic soda, bicarbonate of soda and liquid chlorine. Many uses of these products are charted.

Recent Deaths

John E. Miller

John E. Miller, veteran in glassware manufacturing, died at his home in Washington, Pa., on January 19 at the age of ninety. He had spent seventy-six years in the pressed ware industry, fifty-two of these years with the Duncan & Miller Glass Company and with earlier organizations from which that concern was developed.

Coming Meetings

The American Ceramic Society will hold its annual meeting at the Royal York Hotel, Toronto, Canada, February 16-21, 1930. Details of the **Glass Division** program were given in the December issue. Railroads are giving reduced rates on return trips.

Inquiries Received

For further information address THE GLASS INDUSTRY

483. While in the United States I desire to get in touch with manufacturers of equipment and supplies for a new glass factory which our company plans to build in Venezuela. I am interested in soda ash, borax, aluminum hydrate, burnt lime, selenium, decolorizers, also fuel oil burners, melting furnaces and lehrs.

READERS' WANTS AND OFFERS

ENGINEER

WANTED:—One engineer to design glass factories, must be acquainted with gas-generators, purification of gases and with the management of such factories for services in Russia. Only highly qualified specialists should apply to Morris Holtman, Amtorg Trading Corporation, 261 Fifth Avenue, New York City.

LYNCH MACHINE SPECIALIST

WANTED:—A specialist for the construction and supervision of production of Lynch Machines also for the production of molds. Must be able also to take charge of production of glass with Miller machines and presses and different feeders for them. Position in Soviet Russia. Apply to Morris Holtman, Amtorg Trading Corpotion, 261 Fifth Avenue, New York City.

PLATE GLASS MAN

WANTED:—A specialist in production of plate glass. Must be well acquainted with polishing and grinding of such glass. Service in Russia. Only highly qualified specialists should apply to Morris Holtman, Amtorg Trading Corporation, 261 Fifth Avenue, New York City.

TRIPLEX GLASS EXPERT

WANTED:—A specialist for instruction in the cementing of glass sheets for making Triplex glass. Service in Russia. Apply to Morris Holtman, Amtorg Trading Corporation, 261 Fifth Avenue, New York City.

FOR SALE OR LEASE

Decorating plant—70 x 130 x 40. Fully equipped for decorating glass or china. Two kilns and one large lehr. Also other equipment. Situated at BEAVER, Penna. Address owner—Oscar S. Stein, 709 Leader Bldg., Cleveland, Ohio.

DECORATOR

WANTED—Decorator, man for decorator, for Illuminating Glassware Factory. One acquainted with modern methods of decoration. A knowledge of plate making and etching would be an advantage, but not essential. Reply stating experience, age and salary. Address XYZ, care THE GLASS INDUSTRY, 50 Church Street, N. Y.

Current Prices of Glass-Making Materials

January 20, 1930

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.12½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.38
Alcohol, denatured	gal.	..	.52
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.09¾
Antimony oxide (Sb_2O_3)	lb.	..	.105-.11
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.05
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05-.05½
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	..	..
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.06-.08125
Refined	lb	.0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.00-1.10
Yellow	lb.	..	1.00-1.10
Chromium oxide (Cr_2O_3)	lb.	.24	.25
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.00-2.05
In 10 lb. tins	lb.	..	2.15-2.25
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.28-.30
Black prepared	lb.	.	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	12.50-13.50	20.00 13.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	..	.08¾-.09¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.0450
Black (FeO)	lb.	.04½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	.0875	.0975
Lead oxide (Pb_3O_4) (red lead)	lb.	.0775	.0875
Litharge (PbO)	lb.	..	..
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	..
Burnt (CaO) ground, in bulk	ton	7.00	..
Burnt, ground, in paper sacks	ton	9.00	..
Burnt, ground, in 280 lb. bbls. Per bbl.		2.15-2.25	2.30-2.60
Limestone ($CaCO_3$)		2.00-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¾
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05¾-.06
Potassium permanganate ($KMnO_4$)	lb.	.16	.16½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.80-1.90
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.34¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	1.90
In bags	Per 100 lb.	1.37½-1.40	1.72½
Spot orders .025 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.95	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent	Per 100 lb.	2.16	2.30
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.37½
Tin oxide (SnO_2) in bbls.	lb.	..	.42
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.50-2.00
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

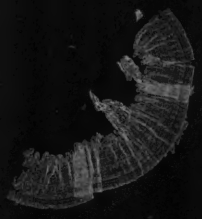
Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to December 23, 1929

	November 1928 Quantity	November 1928 Value	November 1929 Quantity	November 1929 Value	Eleven Months Ending November 1928 Quantity	Eleven Months Ending November 1928 Value	Eleven Months Ending November 1929 Quantity	Eleven Months Ending November 1929 Value
Glass and glass products (Total)	.....	904,318	.....	884,156	.....	9,227,528	.....	10,088,562
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,803	7,929	536	3,709	15,026	88,906	15,166	89,368
Plate glass, unsilvered, sq. ft.	106,279	35,634	212,472	80,790	2,065,343	619,645	1,856,852	674,603
Other window and plate glass lbs.	749,522	67,521	459,052	64,652	3,526,842	395,501	4,375,794	477,679
Glass containers (bottles, vials and jars)	.....	268,564	.....	233,776	.....	3,253,216	.....	3,318,597
Table glassware, plain	.....	141,473	.....	136,378	.....	1,260,816	.....	1,386,276
Table and other glassware, cut or engraved	.....	8,408	.....	16,959	.....	128,069	.....	118,484
Lamp chimneys and lantern globes lbs.	74,146	16,699	104,116	20,666	1,476,996	301,397	1,504,613	302,666
Globes and shades for lighting fixtures lbs.	163,108	61,109	153,283	54,002	1,638,354	584,305	1,910,323	687,391
Chemical glassware lbs.	23,687	20,635	32,289	20,059	208,078	180,256	264,813	223,881
Electrical glassware, except for lighting lbs.	291,315	39,743	256,828	22,629	4,346,884	378,155	4,726,965	391,615
Other glassware	.....	236,603	.....	230,536	.....	2,037,262	.....	2,418,002

IMPORTS

Corrected to December 23, 1929

Glass and glass products	.....	1,247,637	.....	1,053,835	.....	14,108,014	.....	13,113,703
Cylinder, crown and sheet—								
Unpolished, not bent, obscured, beveled, etc.—								
Weighing less than 80 pounds per case dut. lb.	2,366,005	86,909	1,308,857	45,787	33,589,519	1,000,396	32,950,891	906,641
Weighing 80 pounds or over per case dut. lb.	1,433,016	56,682	2,224,826	79,444	27,962,443	1,240,153	31,710,615	1,179,547
Polished and bent, obscured, beveled, colored, etc., unpolished and polished, and all silvered dut.	.....	53,906	.....	40,523	.....	518,954	.....	522,143
Plate glass—								
Polished, unsilvered dut. sq. ft.	1,610,709	311,661	1,042,870	201,356	14,736,015	3,145,293	10,136,990	2,099,361
Other dut. sq. ft.	168,911	33,877	293,442	55,357	1,601,989	403,564	1,491,909	312,312
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	18,598	.....	23,049	.....	225,161	.....	238,922
Table and kitchen utensils dut.	.....	29,395	.....	12,409	.....	264,029	.....	263,838
Glassware, cut or decorated dut.	.....	302,629	.....	293,431	.....	2,660,103	.....	3,068,851
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	88,486	.....	81,458	.....	1,809,197	.....	1,660,924
Bulbs for electric lamps dut. No. 1	1,484,193	14,219	1,299,718	12,785	13,955,139	154,786	14,199,576	128,135
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	93,531	.....	48,470	.....	890,534	.....	749,150
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	37,862	.....	47,399	.....	499,018	.....	604,887
Other glassware dut.	.....	119,882	.....	112,367	.....	1,296,826	.....	1,378,992